Ingenious COCKER! (Now to Rest thou'rt Gone
Noe Art can Show thee fully but thine own.
Thy rare Arithmetick alone can show
The vast Sums of Thanks wee for thy Laboure owe)

Ingenious COCKER! (Now to Reſt thou'rt Gone
Noe Art can Show thee fully but thine own.
Thy rare Arithmetick alone can ſhow
Th^{e} vaſt Sums of Thanks wee for thy Laboure owe)

Cocker's
ARITHMETICK:

BEING

A Plain and familiar Method, ſuitable to the meaneſt Capacity for the full underſtanding of that incomparable Art, as it is now taught by the ableſt School-maſters in City and Country.

COMPOS'D

By *Edward Cocker*, late Practitioner in the Arts of Writing, Arithmetick, and Engraving. Being that ſo long ſince promiſed to the World.

PERUSED and PUBLISHED

By *John Hawkins*, Writing Maſter near St. *George*'s Church in *Southwark*, by the Author's correct Copy, and commended to the World by many eminent Mathematicians and Writing Maſters in and near *London*.

The Thirty-fourth Edition carefully Corrected, with Additions.

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*73-1310a

TO his much Honoured Friends *Manwarning Davies* of the *Inner Temple*, Eſquire, and Mr. *Humphrey Davies* of St. *Mary Newington Butts*, in the County of *Surrey*;

John Hawkins, (As an Acknowledgment of Unmerited Favours) humbly Dedicateth this *Manual of Arithmetick*.

To the READER.

Courteous Reader,

I Having had the Happineſs of an Intimate Acquaintance with Mr. *Cocker* in his Life-time, often ſolicited him to remember his Promiſe to the World, of Publiſhing his *Arithmetick*, but (for Reaſons beſt known to himſelf) he refuſed it; and (after his Death) the Copy falling accidentally into my Hands, I thought it not convenient to ſmother a Work of ſo conſiderable a moment, not queſtioning but it might be as kindly accepted, as if it had been preſented by his own Hand. The Method is familiar and eaſie, diſcovering as well the Theorick as the Practick of that Neceſſary Art of *Vulgar Arithmetick*: And in this new Edition there are many remarkable alterations for the benefit of the Teacher or Learner, which I hope will be very acceptable to the World: I have alſo performed my Promiſe in publiſhing the *Decimal Arithmetick*, which finds Encouragement to my Expectation, and the Bookſellers too. I am

Thine to ſerve thee,

John Hawkins.

Mr. *Edward Cocker's*

PROEME or PREFACE.

B*Y the ſacred Influence of Divine Providence, I have been Inſtrumental to the benefit of many, by vertue of thoſe uſeful Arts,* Writing *and* Engraving*: And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the Publick Treaſury, beſeeching the Almighty to grant the like Bleſſing to theſe as to my former Labours.*

Seven Sciences ſupremely excellent,
Are the chief Stars in Wiſdom's Firmament;
Whereof Arithmetick is one, whoſe worth
The Beams of Profits and Delight ſhines forth;
This crowns the reſt; this makes Man's mind compleat;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this Subject; who in a pleaſing Freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their Expectation, I know not; but this I know, that I have deſigned this Work not extraordinary abſtruſe or profound,

profound, but have by all means poſſible within the Circumference of my Capacity, endeavoured to render it extraordinary uſeful to all thoſe, whoſe Occaſions ſhall induce them to make uſe of Numbers. If it be objected that the Books already publiſhed, treating of Numbers, are innumerable, I Anſwer, that's but a ſmall wonder, ſince the Art is infinite. But that there ſhould be ſo many excellent Tracts of Practical Arithmetick extant, and ſo little practiſed, is to me a greater wonder; knowing that as Merchandize is the Life of the Weal-Publick, ſo Practical Arithmetick is the Soul of Merchandize. Therefore I do ingenuouſly profeſs, that in the beginning of this Undertaking, the numerous Concerns of the honoured Merchant firſt poſſeſſed my Conſideration: And how far I have accommodated this Compoſure for his moſt worthy Service, let his own profitable Experience be judge.

Secondly, *For your Service, moſt excellent Profeſſors, whoſe Underſtandings ſoar to the Sublimity of the Theory and Practice of this Noble Science, was this Arithmetical Tractate Compoſed; which you may pleaſe to imploy as a Monitor to inſtruct your young* Tyroes, *and thereby take occaſion to reſerve your precious Moments, which might be exhauſted that way, for your more important Affairs.*

Thirdly, *For you, the ingenious Off-ſpring of happy Parents, who will willingly pay the full Price of Induſtry and Exerciſe for thoſe Arts and choice Accompliſhments which may contribute to the Felicity of your future State. For you, I ſay, (ingenuous Practitioners) was this Work compoſed, which may prove the Pleaſure of your Youth, and the Glory of your Age.*

Laſtly, *For you the pretended Numeriſts of this vapouring Age, who are more diſingeniouſly witty to propound unneceſſary Queſtions, than ingeniouſly judicious to reſolve ſuch as are neceſſary. For you was this Book compoſed and publiſhed, if you will deny your ſelves ſo much as to invert the ſtreams of your Ingenuity, and by ſtudiouſly conferring with the Notes, Names, Orders, Progreſs, Species, Properties, Proprieties, Proportions, Powers, Affections and Applications of Numbers delivered herein, become ſuch Artiſts indeed, as you now only ſeem to be. This Arithmetick ingenuouſly obſerved, and diligently practiſed, will turn to good account to all that ſhall be concerned in Accompts. All whoſe Rules are grounded on Verity, and delivered with Sincerity. The Examples are built up gradually from the ſmalleſt Conſideration to the greateſt. All the Problems or Propoſitions are well* *weighed, pertinent, and clear, and not one of them throughout the Tract taken upon truſt; therefore now,*

Zoilus and *Momus* lie you down and die,
For theſe Inventions your whole force defie.

Edward Cocker.

Courteous Reader,

BEing well Acquainted with the deceaſed Author, and finding him knowing and ſtudious in the Myſteries of Numbers and Algebra, of which he had ſome choice Manuſcripts, and a great Collection of Printed Authors in ſeveral Languages, I doubt not but he hath writ his Arithmetick ſuitable to his own Preface, and worthy Acceptation; which I thought to certify on a Requeſt to that purpoſe made to him that wiſheth thy Welfare, and the progreſs of Arts.

John Collens.

November 27th, 1677.

This Manuel of Arithmetick is recommended to the World by Us whoſe Names are ſubſcribed, viz.

Mr. *John Collens*
Mr. *James Atkinſon* } Matth.
Mr. *Peter Perkins*
Mr. *Rich Lawrence*, Senior
Mr. *Ele[illegible]ar Wigan*
Mr. *Rich. N[illegible]ble of* Guilford
Mr. *William Norgate*

Mr. *William Maſon*
Mr. *Steph. Thomas*
Mr. *Peter Storey*
Mr. *Benj. Tichbourn*
Mr. *Joſeph Symmonds*
Mr. *Jerem. Milles*
Mr. *Joſiah Cuffley*
Mr. *John Hawkins*

And generally Approved by all Ingenious Artiſts.

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CHAP.

CHAP. I.

Notation of Numbers.

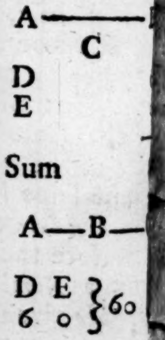
ARithmetick is an Art of Numbering or Knowledge, which teacheth to *Number* well, (*viz.*) the Doctrine of Accounting by *Numbers.* And there are divers Species and Kinds of *Arithmetick* and *Geometry*, the which we do intend to treat of in order; applying the Principles of the one to the Definition of the other. For as Magnitude or Greatneſs is the Subject of *Geometry*, ſo Multitude or Number is the Subject of *Arithmetick*; and if ſo, then their firſt Principles and chief Fundamentals, muſt have like Definitions; or at eaſt, a ſemblable Congruency.

2. *Number* is that, by which the Quantity of any hing is expreſs'd or numbred; as the Unit is the *Number* by which the Quantity of the Thing is expreſs'd or ſaid to be one, and two by which it is nam'd two, and ½ half, by which it is nam'd or called half, and he Root of 3 by which it is called the Root of 3; the ike of any other.

3. Hence it is that Unit is *Number*; for the part is of the ſame Matter that is his whole, the Unit is part of the Multitude of Units, therefore the Unit is of the ſame Matter that is the multitvde of Units; ut the Matter of the multitude of Units is *Number*, herefore the Matter of Unit is *Number*; for elſe if rom a *Number* given no *Number* be ſubtracted, the *Number* given remaineth; let three be the *Number* given; from which *Number* ſubtract or take away one, which as ſome conceive, is no *Number*) therefore the

Number given remaineth, that is to ſay, there remaineth three, which is abſurd.

4. Hence it will be convenient to examine from whence *Number* hath its Riſe or Biginning. Moſt Authors maintain, That Unit is the Beginning of *Number*, and itſelf no *Number*, but looking upon the Principles and Definitions in the firſt Rudiments of Geometry, we ſhall find that the Definition of a Point is in no way congruous with the Definition of an Unit in Arithmetick; and therefore One or Unit muſt be in the Bounds or Limits of Number, and conſequently the beginning of Number is not to be found in the Number One; wherefore we make Number and Magnitude congruent in Principles, and like in Definitions we make and conſtitute a Cypher to be the Beginning of Number, or rather the Medium between increaſing and decreaſing Numbers, commonly called abſolute o whole Numbers, and Negative or Fractional Numbers between which nothing can be imagin'd more agreeable to the Definition of a Point in Geometry; for as Point is an Adjunct of a Line, and itſelf no Line, ſo is (o) Cypher an Adjunct of Number, and itſelf no Number: And as a Point in Geometry cannot be divided or increas'd into Parts; ſo likewiſe (o) cannot be divided or increas'd into Patts: For, as many Points, though i number infinite, do make no Line, ſo many (o) Cyphers, though in Number infinite, do make no Number. For the Line A B cannot be increaſed by the Addition of the Point C, neither can the Number D be increaſed by the Addition of the (o) Cypher E, for if you add nothing to 6, the Sum will be 6, a (o) Cypher neither encreaſing or diminiſhing the Number 6; but if it be granted that A B be extended or prolonged to the Point, C, ſo that A C be made a continued Line, then A B is increas'd by the Addition of the Point C: In like mann



if we grant D (6) be prolonged to E (0) ſo that D E (60) be a continued Number making 60, then 6 is augmented by the Aid of (0) as the conſtituting the Number (60) ſixty; and furthermore that One or Unit is material and a Number, and that (0) is the Beginning of Number, is proved by all Authors, altho' indirectly; for the Tables of Sines and Tangents prove one Degree to be a Number, becauſe the Sine of 1 Degree is 174524 (the Radius being 10000000) and the Beginning of that Table is (0) and it anſwereth 00000, *&c.*

5. Hence it is that Number is not Quantity diſcontinued, for all that which is but one Quantity, is not Quantity disjunct, (60) ſixty as it is a Number, is one Quantity, *viz.* one Number (60) ſixty; therefore as it is Number, it is not Quantity disjunct; for Number is ſome ſuch thing in Magnitude, as Humidity in Water; for as Humidity extends itſelf through all and every Part of Water, ſo Number related to Magnitude, doth extend itſelf through all and every Part of Magnitude. Alſo, as to continued Water doth anſwer continued Humidity, ſo to a continued Magnitude doth anſwer a continued Number. As the continued Humidity of any intire Water, ſuffereth the ſame Diviſion and Diſtinction that his Water doth: So the continued Number ſuffereth the ſame Diviſion and Diſtinction that his Magnitude doth. From all which Conſiderations we might inlarge a farther Digreſſion concerning Number and Magnitude, by comparing the Definitions of the one with the Principles of the other; for having found a (0) Cypher to be the Anſwer in the Definition to a Point in Magnitude, we may very well conclude that Number may be congruent to a Line; as alſo the figurative Number to be conſonant in Definition with a Superficies and Solid, *&c.* in the Order of Geometrical Magnitudes.

6. The Character, or Notes by which Numbers are ſignify'd, or by which a Number is ordinarily expreſs'd are theſe following, *viz.* 0 Cypher or nothing, 1 One, 2 Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, 8 Eight, 9 Nine: The Cypher, which though of it-

ſelf it ſignifies nothing, *viz.* expreſſeth not any certain or known Quantity, but is the Beginning, Radix, or Root of Number, and the other nine Figures or Characters, are call'd ſignificant Figures or Digits.

7. In *Numbers* of any ſort, two Things are to be conſider'd, *viz Notation* and *Numeration.*

8. *Notation* teacheth how to deſcribe any *Number* by certain Notes and Characters, and to declare the Value thereof being ſo deſcrib'd, and that is by Degrees and Periods.

9 A Degree conſiſts of three Figures, *viz.* of three Places, comprehening Units. Tens, and Hundreds; ſo 365, is a Degree, and the firſt Figure (5) on the right Hand, ſtands ſimply for his own Value, being Units, or ſo many Ones *viz.* Five; the ſecond in order from the Right, ſignifies as many times Ten, as there are Units contain'd in it, *viz.* ſixty; the third in the ſame order ſignifies ſo many Hundreds as it contains Units, ſo will the expreſſion of the Number be Three hundned ſixty five, alſo 789, is Seven hundred eighty nine, *&c.*

10. A Period, is when a Number conſiſts of more than three Figures or Places, and whoſe proper Order is to prick or diſtinguiſh every third place, beginning at the Right Hand, and ſo on to the left; ſo the Number 63452 being given, it will be diſtinguſh'd thus, 63.452, and expreſſed thus, Sixty three thouſand, four hundred fifty two; likewiſe 4.578.236.782. being diſtinguſh'd as you ſee, will be expreſs'd thus, Four thouſand, five hundred ſeventy eigth Millions, two hundred thirty ſix thouſand, ſeven hundred eight two.

11. *Number*: is either Abſolute or Negative.

12. Abſolute, or Intire, Whole, Increaſing Number, is that which by annexing another Figure or Cypher, it becomes ten times as much as it ſtood for before; and if two Figures or Cyphers be annex'd, it makes an hundred times as much as it ſtood for before, *&c.* As if you annex to the Figure 6 a Cypher, then it will become (60) ſixty; ſo if two Cyphers are annex'd,

annexed, then it will be (600) ſix hundred, and if you do annex to it a (4) four, then it will be (64) ſixty four; and if you annex (78) ſeventy-eight, it will be then (678) ſix hundred ſeventy-eight, and ſo on. By annexing more Figures or Cyphers, it will encreaſe in a decuple proportion *ad infinitum.*

13. A Negative or Broken, Fractional, Decreaſing Number, is that which by prefixing a Point or Prick towards the Left Hand, its Value is decreaſed from ſo many Units, to ſo many tenth parts of any Thing, and if a Point and (0) Cypher, or Digit be prefixed, it will be then ſo many hundred parts, and if a Point and two Cyphers or Digits be prefixed, its Value is decreaſed to be ſo many thouſandth parts; as if you would prefix before the Figure 3 a Point (.) or Prick thus (.3) it is then decreaſed from 3 Units or 3 Integers, to three tenth parts of an Unit or Integer: And if you prefix an Unit and Cypher thus (.03) it is decreaſed from 3 Integers to 3 hundred parts of an Integer, and by this Means 5 *l.* abſolute, by prefixing of a Point will be decreaſed to .5 *l.* negative, which is 5 tenth parts of a Pound, equal in value to ten Shillings: and ſo by prefixing of more Cyphers or Digits, its value is decreaſed in a decuple proportion *ad Infinitum.* As in the following Scheme, or rather order of Numbers, we have placed ( ) Cypher in its due Place and Order as it is the beginning and medium of Number; for going from (0) towards the Left Hand you deal with intire, abſolute, whole, increaſing Numbers:

Increaſing	*Numbers*				*Decreaſing*	*Numbers*		
29	876	543	256	2 1 0 1 2	345	578	976	3
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	mmm	CX				XC	mmm	m
mm	mmm						XCX	
X	CX							

But going from (0) the place of Units towards the Right Hand, you meet with broken, negative Fractions and decreaſing Numbers. And hence it follows that

Multiplication increaſeth the Product in abſolute Numbers, but decreaſeth the Product in negative Numbers. Alſo Diviſion decreaſeth the Quotient in Whole Numbers, and increaſeth it in negative or fractional Numbers.

14. An abſolute, entire, whole, increaſing Number, hath always a Point annexed towards the Right Hand; and therefore,

15. A negative broken, decimal, decreaſing Number hath always a Point prefixed before it towards the Left Hand. When we expreſs Integers or whole Numbers, as 5 *Pounds*, 5 *Feet*, 26 *Men*, we uſualy annex a
l. feet. Men. inch.
Point or Prick after the Number thus, 5, 5, 26, 347. But when we expreſs *Decimals*, or *Numbers* that are deny'd to be entire, as decreaſing *Numbers*, we do commonly prefix a Point or Prick before the ſaid Decimal or decreaſing Number, thus (.3) that is three tenths, or 3 primes; (.03) that is 3 hundreds, or 3 ſeconds.

16. A whole or abſolute Number is an Unit, or a compoſed Multitude of Units, and it is either a prime or elſe a compound Number.

17. Prime Numbers amongſt themſelves, are thoſe which have no Multitude of Units for a common Meaſurer, as 8 and 7, or 10 and 13, becauſe not any Multitude of Units can equally meaſure or divide them without a Remainder.

18. Compound Numbers amongſt themſelves, are thoſe which have a Multitude of Units for a common Meaſurer, as 9 and 12, becauſe 3 meaſures them exactly, and abbreviates them to 3 and 4.

19. A broken Number, commonly call'd a Fraction, is a part or parts of a whole Number, *viz.* a part of an Integer, as $\frac{1}{3}$ one third, is one third part of an Unit.

20. A broken Number or Fraction, conſiſts of 2 parts, *viz.* the Numerator and Denominator.

21. The Numerator and Denominator of a Fraction are ſet one over the other, with a Line between them; and the Numerator is ſet above the Line, and expreſſeth the Number of Parts therein contained.

22. The Denominator of a Fraction, is the inferior *Number* plac'd below the Line, and expreſſeth the Number of Parts into which the Unit or Integer is divided; as let $\frac{3}{4}$ be the Fraction given, ſo ſhall 3 be the *Numerator*, and doth expreſs or number the Multitude of Parts contain'd in this Fraction, for $\frac{3}{4}$ is a Fraction compounded of Fourths or Quarters; and the Figure 3 in numbring ſhews us, that in that Fraction there are three of thoſe Fourth Parts or Quarters; alſo in the ſame Fraction $\frac{3}{4}$, 4 is the *Denominator*, and doth expreſs the Quality of the Fraction, *viz.* that the whole or Integer is here divided into 4 equal Parts.

23. A *Broken Number*, is either proper or improper, *viz.* proper, when the *Numerator* is leſs than the *Denominator*, for $\frac{3}{4}$ is a perfect proper Fraction; but an improper Fraction hath its *Numerator* greater, or at leaſt equal to the *Denominator*; thus $\frac{13}{8}$ is an improper Fraction, the Reaſon is given in the Definition.

24. A proper *Broken Number*, is either *Simple* or *Compound*; viz. *Simple* when it hath one Denomination, and *Compound*, when it conſiſteth of divers Denominations. If $\frac{3}{4}$ $\frac{6}{12}$, $\frac{35}{100}$, were given, we ſay, they are each of them Single or *Simple Fractions*, becauſe they conſiſt but of one *Numerator*, and one *Denominator*; but if $\frac{5}{4}$ of $\frac{9}{12}$ of $\frac{35}{100}$ of a Pound *Sterling* were given, we ſay, that is a *Compound Broken Number* or *Fraction*, becauſe the Expreſſion and Repreſentation conſiſteth of more Denominations than one; and ſuch by ſome are call'd *Fractions of Fractions*, they have always this Particle (of) between them.

25. When a ſingle *Broken Number* or *Fraction* hath for his *Denominator* a *Number* conſiſting of an Unit in the firſt Place toward the Left Hand, and nothing but Cyphers from the Unit towards the Right Hand it is then the more aptly and rightly call'd a *Decimal Fraction*. under this Head are all our Decreaſing *Nnmbers* plac'd, and in our 13th *Definition*, call'd *Negative*, and by, that Order there preſcrib'd, we order them to be *Decimals*, by ſigning a Point or Prick before them, or the *Numerator*, rejecting the *Denominator*: Therefore ac-

cording to our laſt Rule, $\frac{5}{10}$ $\frac{5}{100}$ $\frac{25}{1000}$, are ſaid to be *Decimals*; and a *Decimal Fraction* may be expreſſed without its *Denomination* (as before) by prefixing a Point or Prick before the *Numerator*, of the ſaid *Fraction*, and then ſhall the former *Fractions* $\frac{5}{100}$ *and* $\frac{25}{1000}$ ſtand thus, .5, .05 and .025.

But oftentimes as in the ſecond and third *Fraction* $\frac{5}{100}$ and $\frac{25}{1000}$ and a prick or pint will not do without the Help of a Cypher or Cyphers prefix'd before the ſignificant Figures of the *Numerator*, and therefore when the *Numerator* of a *Decimal Fraction* conſiſteth not of ſo many Places as the *Deniminator* hath Cyphers, fill up the void Places of the *Numerator*, with prefixing Cyphers before the ſignificant Figures of the *Numerator*, and then ſign it for a *Decimal*, ſo ſhall $\frac{5}{100}$ be .05 and $\frac{25}{1000}$ will be .025, and $\frac{72}{10000}$ will be .0072. Now by this we may eaſily diſcover the *Denominator* having the *Numerator*; for always the *Denominator* of any *Decimal Fraction* conſiſts of ſo many Cyphers, as the *Numerator* hath places, with an Unit prefix'd before the ſaid Cypher, *viz.* under the point or prick.

26 A *Decimal Number* or *Fraction*, is that which is expreſs'd by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. and is Number decreaſing. Here inſtead of *Natural* and *Common Fractions*, as $\frac{3}{4}$ of a Thing, we order the Thing or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifths*, &c. that our Expreſſion may be conſonant to our former Order.

27. In *Decimal Arithmetick* we always imagine (and it would be very commodious if it were always ſo) that all intire Units, Integers and Things are divided firſt into ten equal parts, and theſe parts ſo divided we call *Primes*; and ſecondly, we divide alſo each of the former *Primes* into other ten equal parts, and every of theſe Diviſions we call *Seconds*; and thirdly, we divide each of the ſaid *Seconds* into ten other equal parts, and thoſe ſo divided, we call *Thirds*; and ſo by decimating the former, and ſub-decimating theſe latter, we run on *ad Infinitum*.

28. Let a Pound *Sterling*, *Troy-weight*, *Averdupois-weight*,

Weight, *Liquid-Meaſure*, *Dry-Meaſure*, *Long-Meaſure*, *Time*, *Dozen*, or any other Thing, or Integer be given to be *decimally* divided ; In this Notion premiſed we ought to let the firſt Diviſion be *Primes*, the next Diviſion *Seconds*, the next *Thirds*, &c. So one Pound *Sterling* being 20 Shillings, which divided into ten equal parts, the value of each part will be 2 Shillings; therefore one *Prime* of a Pound *Sterling* will ſtand thus : (.1) which is in Value 2 Shillings; three *Primes* will ſtand thus ; (.3) and that is in Value 6 Shillings, Again, a *Prime* or .1 being divided into ten equal parts, each of thoſe parts will be one *Second*, and is thus expreſs'd, (.01) and its Value will be found to be 2*d.* Farthing and $\frac{6}{10}$ of a Farthing ; and ſo will .05 ſignify one Shilling, or have five *Seconds*. And if .01 be divided into ten other equal parts, each of thoſe parts ſo divided will be *Thirds*, and will ſtand thus, .001, and its Value will be found to be .96 of a Farthing, or $\frac{26}{100}$ of a Farthing, and .009 *Thirds* will be 2 *d.* and .62 of a Farthing, or $\frac{62}{100}$ of a Farthing, *&c.* So that .375 *l.* will be found to repreſent 7 *s.* 6 *d.* for the three *Primes* are 6 Shillings, and the 7 *Seconds* are 1 *s.* 4 *d.* and $\frac{8}{10}$ of a Penny, and the 5 *Thirds* are 1 Penny, and $\frac{2}{1}$. of a Penny, both which added together make 7 *s.* 6 *d.*

21. If you put any Bulk or Body, repreſenting an Integer, if it be *decimally divided*, then the parts in the firſt Decimation are *Primes*, the next *Seconds*, and the next Decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead, or ſuch-like, whoſe Weight let it be 50 *l. Troy*, this call an Unit, Integer, or Thing; then will the like Weight and Matter, make 10 other, the which together, will be equal to 50 *l.* and will weigh each of them 5 *l.* apiece ; take of the ſame Matter; and equal to 5 *l.* make 10 more, then each of thoſe will weigh 6 Ounces apiece ; alſo, if again you take 6 Ounces, and thereof make 10 other ſmall Bullets, each of them will weigh 12 Penny-weight *Troy* and thus have you made *Primes*, *Seconds*, *Thirds*, in reſpect of the Integer, containing 50 *l. Troy-weight* ; So that 5 *Primes* is equal to the half Maſs, and 2 *Primes*, and 5 *Se-*

conds

ſeconds is a quarter of the Maſs; and therefore one of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diiiſion, will be equal in weight to $\frac{1}{2}$ a quarter of the Maſs and contain 6 *l.* 3 Ounces.

30. When a *Decimal Fraction* followeth a *whole Number*, you are to ſeparate or part the *Decimal* from the *whole Number* by a point or prick; ſo if 75 followed the *whole Number* 32, ſet them thus 32.75. You ſhall find that divers Authors have divers ways in expreſſing *mixt Numbers*, as thus, $32|^{75}$, or $32\frac{75}{100}$, or $32\,\overset{..}{75}$, but you will find that 32.75 thus placed and expreſs'd is fitteſt for Calculation.

31. A *mixt Number* hath 2 Parts, the whole and the broken; the whole is that which is compoſed of Integers, and the broken is a *Fraction* annexed thereunto. So the *mixt Number* 36 $\frac{8}{12}$ being given, we ſay that 36 is the *whole Number*, which is compos'd of Integers, and the $\frac{8}{12}$ is the *broken Number* annexed, which ſheweth that one of the former Integers (of that 36) being divided into 13 Parts, $\frac{8}{12}$ doth expreſs 8 of thoſe 12 Parts more, belonging to the ſaid 36 Integers.

32. *Denominative Numbers* are of one, or of many, and thoſe are of divers Sorts and Kinds, *viz. Singular*, called Unit, as 1; and *Plural* called Multitude, as 2, 3, 4, 5; *Single* of one Kind only, call'd *Digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9, and Compounds of many, 10, 11, 12, *&c.* 102, 367, *&c.*

Proportional as Single, Multiple, Double, Triple, Quadruple, *&c.* Denominate, as Pounds, Shillings, Pence; Undenominate, as 1, 2, 3, *&c.* Perfect, as 6, 28, 496, 8128, 130816, 2096128, *&c.* whoſe Parts are equal to the Numbers; Imperfect, unequal and more than the Sum, as 12, to 1, 2, 3, 4, 6; Imperfect, unequal, and leſs than the Sum, as 8, to 1, 2, 4. *Numbers* Commenſurable and Incommenſurable, as 12 and 9 are Commenſurable, becauſe 3 meaſures them both; but 6 and 17 are Incommenſurable, becauſe no one common *Number* or *Meaſure* can meaſure them; Linear; in form of a Line as . ... Superficial, in form of a Superficies or Plane, as : : : :, or ⋮ ⋮ , *&c.* and Number cubical or ſolid in Form of a Cube. Theſe two latter are otherwiſe called figurative Numbers: There are alſo other Numbers called Tabular, as Sines, Tangents, Secants, *&c.* Others that be called Logarithmetick, or borrowed Numbers, fitted to Proportion for each, and ſpeedy Calculation of all Manner of Queſtions.

CHAP. II.

Of the Natural Diviſion of Integers, and the ſeveral Denominations of the Parts.

1. BEFORE we come to Calculation or the ordering of Numbers to operate any Arithmetical Queſtion propoſed, we will lay down Tables of the Denomination of ſeveral Integers; and after that (having mention'd the ſeveral Species and Kinds of *Arithmetick*) we ſhall immediately handle the Species of *Numeration*; which are the main Pillars upon which the whole Fabrick of this Art is built.

Of Money, Weights, &c.

2. The leaſt Denomination or Fraction of Money uſed in *England,* is a Farthing, from whence is produced the following Table, called the *Table of Coyn.*

1 *Farth.*	make	1 *Farthing*
4 *Farth.*		1 *Penny*
12 *Pence.*		1 *Shilling*
20 *Shill.*		1 *Pound*

And therefore,

l.	*s.*	*d.*	*qrs.*
1	20	12.	4
1	20	240	960
	1	12	48
		1.	4

The firſt of theſe Tables, *viz.* that on the Left Hand is plain and eaſy to be underſtood, and therefore wants no Directions. In the ſecond Table above the Line you have 1 *l.* 20 *s.* 12 *d.* 4 *qrs.* whereby is meant, that 1 Pound is equal to 20 Shillings, and one Shilling is equal to 12 Pence, and 1 Penny is equal to 4 Farthings; under the Line is 1 *l.* 20 *s.* 240 *d.* 960 *qrs,* which ſignifies 1 Pound to contain 20 Shillings, or 240 Pence, or 960 Farthings; in the ſecond Line below that is 1 *s.* 12 *d.* 48 *qrs.* the firſt ſtanding under the Denominator of Shillings, whereby is to be noted that 1 Shilling is equal to 12 Pence, or 48 Farthings, and likewiſe that below that, one penny is equal in value to four Farthings; underſtand the like Reaſon in all the following Tables of Weight, and Meaſure, Time, Motion, and Dozen.

Of Troy-weight.

3. The leaſt Fraction or Denomination of Weight uſed in *England* is a Grain of Wheat gathered out of the middle of the Ear, and well dried: from whence are produced theſe following Tables of Weight called *Troy-weight.*

32 *Grains of Wheat*	make	24 *Artificial Grains*
24 *Artificial Grains*		1 *Penny-weight*
20 *Penny-weight*		1 *Ounce*
12 *Ounces*		1 *Pound Troy-weight*

And therefore

l.	*oun.*	*p. w.*	*grains*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy-weight ſerveth only to weigh Bread, Gold, Silver, and Electuaries; it alſo regulateth and preſcribeth a Form how to keep the Money of *England* at a certain

Standard. The *Goldſmiths* have divided the Ounce *Troy-weight* in other parts, which they generally call Mark-weight; the denominative parts thereof are as followeth, *viz.* A Mark (being an Ounce *Troy*) is divided into 24 equal parts called Carects, and each Carect into 4 Grains, ſo that in a Mark are 96 Grains; by this Weight they diſtinguiſh the different fineneſs of their Gold; for if to the fineneſs of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baſer Metal, with which they uſe to mix their Gold or Silver to abate the fineneſs thereof) both making when cold but an Ounce or 24 Carects, then this Gold is ſaid to be 22 Carects fine, for if it come to be refin'd the 2 Carects of Alloy will fly away, and leave only 22 Carects of pure Gold; the like to be conſider'd of a greater or leſſer quantity; and as the fineneſs of Gold is eſtimated by Carects ſo the fineneſs of Silver is diſtinguiſh'd by Ounces; for if a Pound of it be pure and loſeth nothing in the Refining, ſuch Silver is ſaid to be twelve Ounces fine; but if it loſeth any thing, it is ſaid to contain ſo much fineneſs as the loſs wanteth of 12 Ounces, as if it loſt 1 Ounce 14 Penny-weight, then it is ſaid to be 10 Ounces 6 Penny-weight fine, and that which loſeth 2 Ounces 4 Penny-weight 16 Grains, is ſaid to be 9 Ounces 15 Penny-weight 8 Grains fine, *&c.* the like of a greater or leſſer quantity.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights deduc'd from *Troy-weight*, a Pound *Troy* being the greateſt Integer, a Table of whoſe Diviſion and Subdiviſion followeth, *viz.*

1 *pound*	make	12 *ounces*
1 *ounce*	make	8 *drams*
1 *dram*	make	3 *ſcruples*
1 *ſcruple*	make	20 *grains*

And therefore,

l.	*oun.*	*drams*	*ſcrup.*	*gr.*
1	12	8	3	20
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

5. Thus much concerning *Troy-weight*, and its derivative Weights which (as it was ſaid before) ſerveth to weigh Bread, Gold, Silver, and Electuaries; now beſides *Troy-weight*, there is another Kind of Weight uſed in *England*, commonly known by the Name of *Averdupoiſe-weight* (1 Pound of which is equal to 14 Ounces 12 Penny-weight *Troy-weight*) and it ſerveth to weight all kinds of Grocery Wares, as alſo Butter, Cheeſe, Fleſh, Wax, Tallow, Roſin, Pitch, Lead, and all ſuch Kind of Garble, the Table of which Weight is as followeth.

The Table of Averdupois-Weight.

4 *quarters of a dram*	make	1 *dram*
16 *drams*		1 *ounce*
16 *ounces*		1 *pound*
28 *pounds*		1 *quarter of a hundred*
4 *quarters*		1 *hundred weight at* 112 *l.*
20 *hundred*		1 *tun*

And therefore

Tun.	C.	*qr.*	*l.*	*oun.*	*drams*	*qrs.*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wool is weighed with this Weight, but only the Diviſions are not the ſame; A Table whereof followeth.

A Table of the denominative Parts of Wool-Weight.

7 *pounds*	make	1 *clove*
2 *cloves*		1 *ſtone*
2 *ſtones*		1 *todd*
6 *todd* 1 *ſtone*		1 *wey*
2 *weys*		1 *ſack*
12 *ſacks*		1 *laſt*

And therefore,

Laſt	*Sack*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	6½	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	6½	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note, That in ſome Countries, the *Wey* is 256 *l. Averdupois*, as in the *Suffolk-Wey*; but in *Eſſex* there is 336 *l.* in a *Wey*.

6. The leaſt denominative Part of *Liquid-Meaſure* is a Pint, which was formerly taken from *Troy-weight*, (1 Pound of Wheat *Troy-weight* making a Pint of *Liquid-Meaſure*) but in regard of the Difference between the Brewers and Farmers of His Majeſty's Exciſe concerning the Gauging of Veſſels, occaſion'd by the different Opinions of Artiſts, concerning the ſolid Inches in a Gallon; it was lately decided by Act of Parliament, the Statute making 282 ſolid Inches in a Beer-Gallon, and 231 in a Wine-Gallon, and conſequently the Pint Beer-Meaſure to contain 35¼ ſolid Inches, and the Pint Wine-Meaſure to contain 28⅞ cubical or ſolid Inches, from whence is drawn the following Table.

The Table of Liquid-Meaſure.

35¼ *cubical Inches*	make	1 *pint Beer meaſure*
28⅞ *cubical Inches*		1 *pint Wine meaſure.*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
8 *gallons*		1 *firk. of ale, ſoap or beer*
9 *gallons*		1 *firkin of Beer*
10 *gallons and a half*		1 *firk. of Salmon or Eels*
2 *firkins*		1 *kilderkin*
2 *kilderkins*		1 *barrel*
42 *gallons*		1 *tierce of Wine*
63 *gallons*		1 *hogſhead*
2 *hogſheads*		1 *pipe or butt*
2 *pipes or butts*		1 *tun of Wine*

And therefore

tun	*pipes*	*hhds.*	*gall.*	*pints*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8
				1

7. The leaſt denominative part of dry Meaſure is alſo a Pint, and this is likewiſe taken from *Troy-weight*. The Table of whoſe Diviſion followeth.

The Table of dry Meaſure.

1 *pound Troy*	make	1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
2 *gallons*		1 *peck*
4 *pecks*		1 *buſhel*
4 *buſhels*		1 *comb*
2 *combs*		1 *quarter*
4 *quarters*		1 *chaldron*
5 *quarters*		1 *Wey*
2 *Weys*		1 *laſt*

And therefore

laſt	*wey*	*qrs.*	*com.*	*buſh.*	*pecks*	*gall.*	*pints.*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	5	10	40	160	320	2560
		1	2	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The leaſt denominative part of *Long-meaſure* is a Barly-corn well dried and taken out of the middle of the Ear; whoſe Table of parts followeth.

3 *Barly-corns*	make	1 *inch*
12 *inches*		1 *foot*
3 *feet*		1 *yard*
3 *feet 9 inches, or a yard and a quarter*		1 *ell Engliſh*
6 *feet*		1 *fathom*
5 *yards and a half*		1 *pole, perch, or rod*
40 *poles or perches*		1 *furlong*
8 *furlongs*		1 *Engliſh mile*

And therefore

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barly-corns*
1	8	40	5½	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	5½	16½	198	594
			1	3	36	108
				1	12	36
					1	3

And note, that the Yard, as alſo the Ell, is uſually divided into 4 quarters, and each quarter into 4 Nails.

Note alſo, that a Geometrical Pace is 5 Feet; and there are 1056 ſuch Paces in an *Engliſh* Mile.

9. The parts of the Superficial Meaſures of Land are ſuch as are mention'd in the following Table, *viz.*

A Table of Land-Meaſure.

40 *ſquare Poles or Perches*	make	1 *Rood, or quarter of an Acre.*
4 *Roods*		1 *Acre.*

By the foregoing *Table of Long-Meaſure*, you are inform'd what a Pole, or (which is all one) a Perch is; and by this that 40 ſquare Perches is a Rood. Now a ſquare Perch is a Superficies very aptly reſembled by a ſquare Trencher, every ſide thereof being a Perch, of 5 Yards and an half in length, 40 of them is a Rood, and 4 Roods an Acre. So that a Superficies that is 40 Perches long and 4 broad is an Acre of Land, the Acre containing in all 160 Perches.

10. The leaſt denominative Part of Time is a *Minute*, the greateſt Integer being a *Year*, from whence is produc'd this following Table.

The Table of Time.

1 *Minute*	make	1 *Minute*
60 *Minutes*		1 *Hour*
24 *Hours*		1 *Day Natural*
7 *Days*		1 *Week*
4 *Weeks*		1 *Month*
13 *Months*, 1 *Day*, 6 *Hours*		1 *Year*

But the Year is uſually divided into 12 unequal *Kalendar Months*, whoſe Names and the Number of Days they contain follow, *viz.*

	Days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
Auguſt	31
September	30
October	31
November	30
December	31

So that the Year containeth 365 Days, and 6 Hours; but the 6 Hours are not reckon'd but only every 4th Year, and then there is a Day added to the latter end of *February*, and then it containeth 29 Days, and that Year is call'd Leap Year, and containeth 366 Days.

And here *Note*, That as the Hour is divided into 60 Minutes, ſo each Minute is ſubdivided ivto 60 econds, and each Second into 60 Thirds, and each Third into 60 Fourths, *&c.*

The Tropical Year, by the exacteſt Obſervation of the moſt Accurate *Aſtronomers*, is found to be 365 Days, 5 Hours, 49 Minutes, 4 Seconds, and 21 Thirds.

CHAP. III.

Of the Species or Kinds of Arithmetick.

A*Rithmetick* is either Natural, Artificial, Analytical, Algebraical, Lineal, or Inſtrumental.

2. Natural Arithmetick, is that which is perform'd by the Numbers themſelves; and this is either Poſitive or Negative. Poſitive, which is wrought by certain infallible Numbers propounded, and this is either Single or Comparative: Single, which conſidereth the Nature of Numbers ſimply by themſelves; and Comparative, which is wrought by Numbers that have Relation to one another. And the Negative Part relates to the *Rule of Falſe*.

3. Artificial (by ſome the Logaritmetical) *Arithmetick*, is that which is perform'd by Artificial or borrow'd Numbers invented for that Purpoſe, and are call'd Logarithms.

4. Analytical Arithmetick, is that which ſhews from a Thing unknown to find truly that which is ſought, always keeping the Species without Change.

5. Algebraical Arithmetick, is an obſcure and hidden Art of Accompting by Numbers in reſolving of hard Queſtions.

6. Lineal Arithmetick, is that which is perform'd by Lines fitted to Proportion, as Geometrical Projections.

7. Inſtrumental Arithmetick, is that which is perform'd by Insttuments fitted with Circular and Right Lines of Proportion, by the Motion of an Index, or otherwiſe.

8. The Parts of Single Arithmetick are Numeration, and the Extraction of Roots.

9. Numeration, is that by which certain known Numbers propounded, we diſcover another number unknown.

10. *Numeration* hath four Species, *viz. Addition, Subtraction, Multiplication,* and *Diviſion.*

CHAP. IV.

Addition of Whole Numbers.

1. A*Ddition* is the Reduction of two or more *Numbers* of like kind together into one Sum or Total. Or it is that by which divers numbers are added together, to the end that the Sum or Total value of them all may be diſcovered.

The firſt Number in every *Addition*, is call'd *Addible Number*, the other, the *Number* or *Numbers* added, and the *Number* invented by the *Addition* is called the *Aggregate* or *Sum* containing the Value of the *Addition.*

The Collation of the numbers, is the right placing the numbers given reſpectively to each Denomination, and the Operation, is the Artificial adding of the numbers given together in order to the finding out of the *Aggregate* or *Sum.*

2. In *Addition* place the numbers given reſpectively the one above the other, in ſuch ſort, that the like degree, place or denomination, may ſtand in the ſame Series, *viz,* Units under Units, Tens under Tens, Hundreds under Hundreds, *&c.* Pounds under Pounds, Shillings under Shillings, Pence under Pence, *&c.* Yards under Yards, Feet under Feet, *&c.*

3. Having thus placed the numbers given (as before) and drawn a Line under them, add them together, beginning with the leſſer Denomination, *viz,* at the Right Hand; and ſo on ſubſcribing the Sum under the Line reſpectively; as for Example.

Let there be given 3352, and 213, and 133, to be added together, I ſet the Units in each particular Number under each other, and ſo likewiſe the Tens under the Tens, *&c.* and draw a Line under them, as in the Margent; then I begin at the place of Units, and add them together upwards, ſaying, 3 and 3 are 6, and 2 make 8, which I ſet under the Line, and under the ſame Figures added together; then I proceed in the next place, being the place of Tens, and add them up in the ſame manner as I did the place of Units, ſaying, 3 and 1 are 4, and 5 are 9, which I likewiſe ſet under the Line reſpectively; then I go to the place of Hundreds, and add them up as I did the other, ſaying, 1 and 2 are 3, and 3 are 6, which is alſo ſet under the Line; and laſtly, I go to the place of Thouſands, and becauſe there are no other Figures to add to the 3, I ſet it under the Line in its reſpective place, and ſo the Work is finiſh'd; and I find the Sum of the 3 given Numbers to be 3698.

3352
213
133
——
3698

4. But if the Sum of the Figures of any Series exceedeth Ten or any number of Tens, ſubſcribe under the ſame the exceſs above the Ten, and for every Ten carry One to be added to the next Series towards the Left Hand, and ſo go on till you have finiſh'd your Addition; always remembring, that how great ſoever the Sum of the Figures of the laſt Series is, it muſt all be ſet down under the Line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the Margent, with a Line drawn under them, then I begin and add them together, ſaying, 7 and 8 are 15, which is 5 above 10, wherefore I ſet 5 under the Line, and carry 1 for the 10 to be added to the next Series, ſaying, 1 that I carry'd and 5 is 6, and 7 are 13, wherefore I ſet down 3 and carry 1 (for the Ten) to the next Series; then I ſay, 1 that I carry'd and 3 are 4, and 6 are 10, now becauſe it comes to juſt 10 and no more, I ſet 0 under the Line and carry 1 for the 10 to the next, and ſay, 1 that

3678
2357
——
6035

that I carried and 2 are 3 and three are 6, which I ſe down in its reſpective Place ; thus the Addition is end ed, and the total Sum of theſe *Numbers* is found to b 6035. Several Examples of this kind follow.

Numbers to be added
354867
573846
785946
347295

Sum 2061864

Numbers to be added
748647
465834
76483
648300

Sum 1939264

Numbers to be added
45346
38074
8437
923
76

Sum 92856

5. If the Numbers given to be added, are contained under divers Denominations, as of *Pounds*, *Shillings*, *Pence* and *Farthings* ; or of *Tuns*, *Hundreds*, *Quarters*, *Pounds*, &c. Then in this Caſe having diſpoſed of the Numbers, each Denomination under other of the like Kind ; beginning at the leaſt Denomination, (minding how many of one Denomination do make an Integer in the next) and having added them up, for every Integer of the next greater Denomination that you find therein contained, bear an Unit in Mind to be added to the ſaid next greater Denomination, expreſſing the Exceſs reſpectively under the Line, proceed in this manner until yout Addition be finiſhed ; the following Example will make the Rule plain to the Learner. Thus theſe following Sums being given to be added, *viz.* 136 *l.* 13 *s.* 4 *d.* 2 *qrs.* and 79 *l.* 07 *s.* 10 *d.* 3 *qrs.* and 33 *l.* 18 *s.* 09 *d.* 1 *qr.* alſo 15 *l.* 09 *s.* 05 *d.* 0 *qrs.* The Numbers being diſpoſed according to Order, will ſtand as in the Margent. Then I begin at the Denomination of Farthings, and

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2

and add them up ſaying, 1 and 3 are 4, and 2 makes 6. Now I conſider that 6 Farthings are 1 Penny and 2 Farthings, wherefore I ſet down the 2 Fatthings in its place under the Line, and keep 1 in mind to be added to the next Denomination of Pence: then I go on ſaying, 1 that I carried and 5 are 6, and 9 are 15 and 10 are 25, and 4 are 29; now I conſider that 29 Pence are 2 Shillings and 5 Pence, therefore I ſet the 5 Pence in order under the Line, and keep 2 in mind for the 2 Shillings, to be added to the Shillings; then I go on ſaying, 2 that I carry'd and 9 are 11, and 18 are 29, and 7 are 36, and 13 are 49; then I conſider that 49 Shillings are 2 Pounds and 9 Shillings, wherefore I ſet the 9 Shillings under the Line, and carry the 2 for the 2 Pounds to the next and laſt Denomination of Pounds, and proceed, ſaying, 2 that I carry'd and 5 make 7, and 3 are 10, and 9 are 19, and 6 are 25, then I ſet down 5, and carry 2 for the 2 Tens; and proceed, ſaying, 2 that I carry and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16, and I ſet down 6 and carry 1 for the 10, and go on, ſaying, 1 that I carry'd and 1 are 2, which I ſet in its place under the Line, and the Work is finiſh'd; and thus I find the Sum of the foreſaid Numbers to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* This to the ingenious Practitioner is ſufficient; but I ſhall (for the further Illuminating of the weaker Apprehenſions) explain the Operation of another Example in *Troy-weight*; and here the Learner muſt take Notice of the Table of *Troy-weight*, mention'd or ſet down in the third Section of the Second Chapter. The Numbers given in this Example are 38 *l.* 7 *oz.* 13 *p.w.* 18 *gr.* and 50 *l.* 10 *oz.* 10 *p.w.* 12 *gr.* and 42 *l.* 08 *oz.* 05 *p. w.* 16 *gr.* and in order to the Addition thereof, I place them as you ſee, and proceed to Operation; ſaying, 16 and 12 are 28, and 18 are 46; now becauſe [illegible] Grains make 1

1 Penny-weight, 46 Grains are 1 Penny-weight, and 22 Grains, wherefore I ſet down 22, and carry 1 for the Penny-weight, and 5 makes 6, and 10 are 16, and 13 are 29, which is one Ounce and 9 Penny-weight. I ſet down 9 in its place under the Line, and carry 1 to the Ounces, ſaying, 1 that I carry, and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 Ounces make 2 Pounds 2 Ounces, I ſet down 2 for the Ounces, and carry 2 to the Pounds; going on, 2 that I carry and 2 are 4, and 8 makes 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10, and 3 are 13, which I ſet down as in the Margent, and the Work is finiſhed, and I find the Sum of the ſaid Numbers to amount to 132 *l.* 02 *oz.* 9 *q w.* 22*gr.* This is ſufficient for the underſtanding of the following Examples, or any other that ſhall come to thy View. The Way of proving theſe, or any Sum in this Rule, is ſhew'd immediately after the enſuing Examples.

l.	*oz.*	*p w.*	*gr.*
38	07	13	18
50	10	10	12
42	08	05	16
132	02	09	22

Addition of English Money.

l.	s.	d.	qrs.
436	13	07	1
184	09	10	3
768	17	04	2
564	11	11	0
1954	12	09	2

l.	s.	d.	qrs.
48	15	11	1
76	10	07	3
18	00	05	3
24	19	09	2
168	06	10	1

Addition of Troy-weight.

l.	oz.	p.w.	gr.
15	07	13	12
18	06	04	20
11	10	16	18
09	04	10	22
19	11	18	04
22	00	00	00
97	05	04	04

l.	oz.	p.w.	gr.
145	09	12	18
726	08	14	10
389	07	06	13
83	10	16	20
130	00	10	12
74	07	15	00
1550	08	16	01

Addition of Apothecaries Weights.

l.	*oz.*	*dr.*	*ſc.*	*gr.*
48	07	1	0	14
74	05	5	2	10
64	10	7	1	16
17	08	1	0	11
34	09	6	1	09
240	05	5	1	00

l.	*oz.*	*dr.*	*ſc.*	*gr.*
60	03	4	0	10
48	10	6	0	14
34	08	2	1	15
18	11	2	2	11
160	07	1	2	15
35	02	5	1	07
358	07	7	7	12

Addition of Averdupois Weight.

Tun	C.	*qrs.*	*l.*
75	13	1	15
48	07	3	21
60	11	1	17
21	07	0	25
12	16	0	11
218	17	0	05

l.	*oun.*	*dr.*
36	10	12
22	11	13
11	07	04
15	04	10
20	30	09
106	03	00

Addition of Liquid Meaſure.

Tun	*pipe*	*hhd.*	*gal.*
45	1	1	48
15	0	1	17
38	0	0	47
12	1	0	56
21	1	1	18
133	1	1	60

Tun	*hhd.*	*gal.*	*pts.*
30	3	40	4
12	0	28	6
47	5	60	5
57	3	22	3
17	0	00	0
168	1	20	2

Addition of Dry-Meaſure.

Chald.	*qrs.*	*buſh.*	*pec.*
48	3	7	3
13	1	4	0
54	0	6	2
16	3	6	1
40	1	0	1
173	3	0	3

qrs.	*buſh.*	*pec.*	*gall.*
17	3	1	1
50	1	3	0
14	5	3	1
40	2	0	1
30	0	3	0
152	5	3	1

Addition of Long-Meaſure.

yds	*qrs.*	*nails.*
35	3	3
14	1	2
74	2	3
38	0	1
30	1	0
15	0	0
208	1	1

ells.	*qrs*	*nails.*
56	1	3
13	3	2
48	2	1
50	1	0
74	0	2
17	1	0
260	0	0

Addition of Land-Meaſure.

Acre	*rood*	*perc.*
12	3	18
14	0	24
30	2	19
48	3	30
28	1	38
50	3	26
185	3	35

Acre	*rood*	*perc.*
86	1	36
47	3	24
73	2	18
60	0	07
04	2	08
14	1	14
286	3	27

The Proof of Addition.

6. *Addition* is prov'd after this Manner: When you have found out the Sum of the Number given, then ſeparate the uppermoſt Line from the reſt with a ſtroke or daſh of the Pen, and then add them all up again as you did before, leaving out the uppermoſt Line; and having ſo done, add this new invented Sum to the uppermoſt Line you ſeparated, and if the Sum of thoſe two Lines be equal to the Sum firſt found out, then the Work was performed true, otherwiſe not. As for Example; Let us prove the firſt Example of *Addition of Money*, whoſe Sum we find to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* and which we prove thus; Having ſeparated the uppermoſt Number from the reſt by a Line, as you ſee in the Margent, then I add the ſame together again, leaving out the ſaid uppermoſt Line, and the Sum thereof I ſet under the firſt Sum or true Sum, which doth amount to 128 *l.* 16 *s.* 1 *d.* 0 *qrs.* then again, I add this new Sum to the uppermoſt Line that before was ſeparated from the reſt, and the Sum of thoſe two is 265 *l.* 09 *s.* 05 *d.* 2 *qrs.* the ſame with the firſt Sum, and therefore I conclude that the Operation was rightly perform'd.

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
34	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	09	05	2

7. The main End of *Addition* in Queſtions reſolvable thereby, is to know the Sum of ſeveral Debts, Parcels, Integers, *&c.* Some Queſtions may be theſe that follow.

Queſt. 8. There was an old Man whoſe Age was requir'd; to which he reply'd, I have ſeven Sons, each having two Years between the Birth of each other, and in the 44th Year of my Age my eldeſt Son was born, which is now the Age of the youngeſt. I demand, What was the old Man's Age?

Now to reſolve this Queſtion, firſt ſet down the Father's Age at the Birth of his firſt Child which was 44, then the Difference between the oldeſt and the youngeſt, which is 12 Years, and then the Age of the youngeſt, which is 44, and then add them all together, and their Sum is 100, the compleat Age of their Father.

44
12
44
100

Queſt. 2. A Man lent his Friend at ſeveral Times, theſe ſeveral Sums, *viz.* At one Time 63 *l.* at another Time 50 *l.* at another Time 48 *l.* at another Time 156 *l.* Now I deſire to know how much was lent him in all?

Set the Sums lent one under another, as you ſee in the Margent, and then add them together, and you will find their Sum to amount to 317 *l* which is the total of all the ſeveral Sums lent, and ſo much is due to the Creditor.

63
50
48
156
317

Queſt. 2. From *London* to *Ware* is 20 Miles, thence to *Huntington* 29 Miles, thence to *Stamford* 21 Miles, thence to *Tuxford* 36 Miles, thence to *Wentbridge* 25 Miles, from thence to *York* 20 Miles. Now I deſire to know how many Miles it is from *London* to *York*, according to this Reckoning?

Now to anſwer this Queſtion; ſet down the ſeveral Diſtances given, as you ſee in the Margent, and add them together, and you will find their Sum to amount to 151, which is the true Diſtance in Miles between *London* and *York*.

20
29
21
36
25
20
151

Queſt. 4. There are two Numbers, the leaſt whereof is 40, and their Difference 14. I deſire to know what is the greater Number, and alſo what is the Sum of them both? Firſt ſet down the leaſt, (*viz*) 40, and 14, the Difference, and add them together, and their Sum is 54 for the greateſt Number, then I ſet 40 (the leaſt) under

40
14
greateſt 54
leaſt 40
Sum 94

der 54 (the greateſt) and add them together; and their Sum is 94 equal to the greateſt and leaſt Numbers.

CHAP. V.

Of Reduction of whole Numbers.

SUBSTRACTION is the taking of a leſſer Number out of a greater of a like Kind, whereby to find out a third Number, being or declaring the inequality, exceſs, or difference between the Numbers given; or *Subſtraction* is that by which one Number is taken out of another Number given, to the end that the Reſidue or Remainder may be known, which Remainder is alſo called the Reſt, Remainder, or Difference of the Numbers given.

2. The Number out of which *Subſtraction* is to be made, muſt be greater, or at leaſt equal with the other Number given; the higher or ſuperiour Number is called the *Major* Number, and the lower or inferior is called the *Minor* Number; and the Operation of *Subſtraction* being finiſh'd, the Reſt or Remainder is called the Difference of the Numbers given.

3. in *Subſtraction* place the Numbers given reſpectively, the one under the other, in ſuch ſort as like Degrees, Places or Deuominations, may ſtand in the ſame Series, *viz.* Units under Units, Tens, under Tens, Pounds under Pounds, *&c.* Feet under Feet, and Part under Parts, *&c.* This being done, draw a Line underneath, as in *Addition*.

4. Having placed the Numbers given as is before directed, and drawn a Line under them, ſubſtract the lower Number (which in this Caſe muſt always be leſs than the uppermoſt) out of the higher Number, and ſubſcribe the difference or Remainder reſpectively below the Line; and when the Work is finiſhed, the

Number below the Line will give you the Remainder.

As for Example, Let 364521 be given to be ſubtracted from 795836, I ſet the leſſer under the greater, as in the Margent, and draw a Line under them, then Beginning at the Right Hand, I ſay, 1 out of 6, and there remains 5, which I ſet in order under the Line; then I proceed to the next, ſaying, 2 from 3 reſts 1, which I note alſo under the Line; and thus I go on till I have finiſhed the Work; and then I find the Remainder or Difference to be 401315.

795836
394521
———
401315

But if it ſo happen (as commonly it doth) that the lowermoſt Number or Figure is greater than the uppermoſt; then in this Caſe add ten to the uppermoſt Number, and ſubtract the ſaid lowermoſt Number from their Sum, and the Remainder place under the Line, and when you go to the next Figure below pay an Unit by adding it thereto for the ten you borrowed before, and ſubtract that from the higher Number of Figures; and thus go on till your Subtraction be finiſhed. As for Example, Let 437503 be given, from whence it is required to ſubtract 153827, I diſpoſe of the Numbers as is before directed, and as you ſee in the Margent; then I begin, ſaying, 7 from 3 I cannot, but (adding 10 thereto) I ſay, 7 from 13 and there remains 6, which I ſet under the Line in order; then I proceed to the next Figure, ſaying, 1 that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7, which I likewiſe ſet down as before; then 1 that I borrowed and 8 is nine, from 5 I cannot but 9 from 15 and there remains 6; then 1 borrowed and 3 is 4 from 7 and there remains 3; then 5 from 3 I cannot, but 5 from 13, and there remains 8; then 1 I borrowed and 1 are 2 from 4, and there reſts 2; and thus the Work is finiſhed: And after theſe Numbers are ſubtracted one from another, the Inequality, Remainder, Exceſs or Difference, is found to be 283676

437503
153827
———
283676
———

283676. Examples for thy farther Experience may be theſe that follow.

From	3469916	From	361576
Take	738642	Take	5864
Reſts	2731274	Reſts	355712

6. If the Sum or Number to be ſubtracted is of ſeveral Denominations, place the leſſer Sum below the greater, and in the ſame Rank and Order, as is ſhewed in *Addition* of the ſame Numbers; then begin at the Right Hand and take the lower Number out of the uppermoſt, if it be leſſer; but if it be bigger than the uppermoſt, then borrow an Unit from the next greater Denomination, and turn it into the parts of the leſs Denomination, and add thoſe parts to the uppermoſt, noting the Remainder below the Line; then proceed and pay 1 to the next Denomination for that which you borrowed before, and proceed in the Order until the Work be finiſh'd. An Example of this Rule may be this that followeth; Let 375 *l.* 13 *s.* 7 *d.* 1 *qr.* be given, from whence let it be required to ſubtract 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto, I place the Numbers as you ſee in the Margent; and thus I begin at the leaſt Denomination, ſaying, two from one I cannot, therefore I borrow one penny from the next Denomination, and turn it into Farthings, which is four, and adding 4 to 1 which is 5, I ſay, but 2 from 5, and there remains 3, which I put under the Line, then going on, I ſay, 1 that I borrowed and 3 is 4 from 7, and there reſts 3; then going on, I ſay, 16 from 13 I cannot, but borrowing 1 Pound, and turning it into 20 Shillings, I add it to 13, and that is (33) wherefore I ſay, 16 from 33, and there remains 17, which I ſet under the Line, and go on, ſaying, 1 that I borrowed and 7 is 8 from 5 I cannot, but 8 from 15, and there remains 7; the one that I borrowed

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

borrowed and 5 is 6 from 7 there reſts 1, and 0 from 3 reſts 3, and the Work is done. And I find the Remainder or difference to be 327 *l.* 17 *s.* 3 *d.* 3 *qrs.*

Another Example of *Troy-weight*, may be this, I would ſubſtract 17 *l.* 10 *oz.* 11 *p. w.* 20 *gr.* from 24 *l.* 05 *oz.* 00 *p. w.* 08 *gr.* I place the Numbers according to the Rule, and begin ſaying, 20 from 8 I cannot, but borrow 1 *Penny-weight*, which is 24 *Grains*, and add them to 8 and they are 32, wherefore I ſay, 20 from 32 reſts 12; then 1 that I borrowed and 11 is 12 from 00 I cannot, but 12 from 20 (borrowing an Ounce, which is 20 *Penny-weight*) and there remains 8; then 1 that I borrowed, and 10 is 11 from 5 I cannot, but 11 from 17 and there reſts 6; then 1 that I borrowed, and 7 is 8 from 4 I cannot, but 8 from 14 and there reſts 6; then 1 that I borrowed and 1 is 2 from 2 and there reſts nothing; ſo that I find the Remainder or Difference to be 6 *l.* 6 *oz.* 8. *p. w* 12 *gr.*

l.	*oz.*	*p. w*	*gr*
24	05	00	08
17	10	11	20
06	06	08	12

7. It many times happeneth that you have many Sums or Numbers to be ſubſtracted from one Number, as ſuppoſe a Man ſhould lend his Friend a certain Sum of Money, and his Friend hath paid him part of his Debt at ſeveral times, then before you can conveniently know what is ſtill owing, you are to add the ſeveral Numbers or Sums of Payments together, and ſubſtract their Sum from the whole Debt, and the Remainder is the Sum due to the Creditor; As ſuppoſe A lendeth to B 564 *l.* 16 *s.* 10 *d.* and B hath repaid him 79 *l.* 16 *s.* 8 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l* 15 *s.* 8 *d.* at another time; and you would know how the Accompt ſtandeth between them or what more is due to A, In order whereunto I firſt

	l.	*s.*	*d.*
Lent	564	16	10
Paid at	79	16	08
ſeveral	163	18	11
Payments	241	15	08
Paid in all	485	11	03
Remains	79	05	07

I firſt ſet down the Sum which A lent, and draw a Line underneath it, then under that Line ſet the ſeveral Sums of Payment as you ſee in the Margent; and having brought the ſeveral Sums of Payment into one Total by the fifth Rule of the fourth Chapter foregoing, I find their Sum amounteth to 485 *l.* 11 *s.* 3 *d.* which I ſubſtract from the Sum firſt lent by A, by the ſixth Rule of this Chapter, and I find the Remainder to be 79 *l.* 5 *s.* 7 *d.* and ſo much is ſtill due to A.

When the Learner hath good Knowledge of what hath been already delivered in this and the foregoing Chapter, he will with Eaſe underſtand the Manner of working the following Examples.

Subſtraction of Whole Money.

	l.	*s.*	*d.*
Borrowed	374	10	03
Paid	79	15	11
Remains	294	14	04

	l.	*s.*	*d.*	*qrs.*
Borrowed	700	10	11	2
Paid	9	03	11	3
Remains	691	06	11	3

	l.	*s.*	*d.*
Borrowed	1000	00	00
Paid	19	00	06
Rem. due	980	19	09

	l.	*s.*	*d.*	*qrs.*
Borrowed	711	03	00	0
Paid	11	13	00	1
Rem. due	699	09	11	3

	l.	*s.*	*d.*	*qrs.*
Borrowed	3300	00	00	0
Paid at ſeveral Payments	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	02	3
Remains due	2104	07	09	1

Subtraction of Troy-weight.

	l.	oz.	p.w.	gr.
Bought	174	00	13	00
Sold	78	04	16	15
Remains	95	07	16	09

	l.	oz.	p.w.	gr.
Bought	470	10	13	00
Sold at ſeveral times	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Remains unſold	225	00	05	17

Subtraction of Apothecaries Weights.

	l.	oz.	dr.	ſc.	gr.
Bought	12	04	3	0	00
Sold	8	05	1	1	15
Remains	03	11	1	1	05

l.	oz.	dr.	ſc.	gr.
20	00	1	0	07
10	00	1	2	12
9	11	7	0	15

Subtraction of Averdupois-weight.

	C.	qrs.	l.
Bought	35	0	15
Sold	16	2	20
Remains	18	2	23

Tu.	C.	qrs.	l.	oz.	dr.
5	07	1	10	10	05
3	17	1	16	09	13
1	09	3	22	00	08

Subtraction of Liquid Meaſure.

	Tuns. hhd. gall.	*Tuns hhd. gall. pin.*
Bought	40 : 1 : 30	60 : 3 : 42 : 4
Sold	16 : 1 : 40	15 : 3 : 46 : 6
Remains	23 : 3 : 53	44 : 3 : 58 : 6

Subtraction of Dry Meaſure.

	Chald. qrs. buſh. pec.	*Chald. qrs. buſh. pec.*
Bought	100 : 0 : 0 : 0	73 : 2 : 3 : 2
Sold	54 : 1 : 4 : 3	46 : 2 : 3 : 3
Remains	45 : 2 : 3 : 1	26 : 3 : 7 : 3

Subtraction of Long Meaſure.

	yards qrs. nails	*yards qrs. nails.*
Bought	160 : 0 : 0	344 : 0 : 1
Sold	64 : 1 : 2	177 : 1 : 3
Remains	95 : 3 : 2	166 : 2 : 2

Subtraction of Land Meaſure.

	Acres rood perch.	*Acres rood perch*
Bought	140 : 2 : 13	600 : 0 : 00
Sold	70 : 3 : 12	54 : 0 : 16
Remains	69 : 2 : 01	545 : 3 : 34

The Proof of Subtraction.

8.§ When your Subtraction is ended, if you deſire to prove the Work, whether it be true or no; then add the Remainder to the minor Number, and if the Aggregate of theſe two be equal to the major Number, then is your Operation true, otherwiſe falſe: Thus let us prove the firſt Example of the fifth Rule of this Chapter, where, after Subſtraction is ended, the Numbers ſtand as in the Margent; the Remainder or Difference being 283676. Now to prove the Work, I add the ſaid Remainder 283676 to the minor Number 153827, by the fourth Rule of the fore-going Chapter, and I find the Sum or Aggregate to be 437503, equal to the major Number, or Number from whence the leſſer is ſubſtracted. Behold the Work in the Margent.

437503
153827
283676
437503

The Proof of another Example, may be of the firſt Example of the ſixth Rule of this Chapter, where it is requir'd to ſubſtract 57 *l.* 16 *s.* 3 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 7 *d.* 1 *qr* and by the Rule I find the Remainder to be 317 *l.* 17 *s.* 3 *d.* 3 *qrs.* Now to prove it, I add the ſaid Remainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor Number 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* and their Sum is 375 *l.* 13 *s.* 07 *d.* 1 *qr.* equal to the major Number, which proves the Work to be true; but if it had happen'd to have been either more or leſs thna the ſaid major Number, then the Operation had been falſe,

l. *s.* *d.* *qrs.*
375—13—07—1
57—16—03—2
317—17—3—3
374—13—07—2

6. The general Effect of *Subſtraction*, is, to find the Difference or Exceſs between two Numbers, and the Reſt when a Payment is made in part of a greater Sum, the Date of Books printed, the Age of any thing, by knowing the preſent Year, and the Year wherein they were made, created, or built, and ſuch-like.

The Queſtions appropriated to this Rule, are ſuch as follow.

Queſt. 1. What Difference is there between one Thing of 125 Foot long, and another of 66 Foot long?

To reſolve this Queſtion, I firſt ſet down the major or greater Number 125, and under it the minor or leſſer Number 66, as is directed in the third Rule of this Chapter, and according to the fourth Rule of the ſame, I ſubſtract the minor from the major, and the Remainder, Exceſs or Difference, I find to be 59. See the Work in the Margent.

125
66
59

Queſt. 2. A Gentleman oweth a Merchant 365 *l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an Anſwer to this Queſtion, I firſt ſet down the major Number 365 *l.* and under it I place 278 the minor, and ſubſtract the one from the other, thereby I diſcover the Exceſs, Difference or Remainder, to be 87, and ſo much is ſtill due to the Creditor; as *per* Margent.

365
278
87

Queſt. 3. An Obligation was written, a Book printed, a Child born, a Church built, or any other Thing made in the Year of our Lord 1572, and now we account the Year of our Lord 1687, the Queſtion is to know the Age of the ſaid Things; that is, how many Years are paſs'd ſince the ſaid Thiugs were made? I ſay, if you ſubſtract the leſſer Number 1572, from the greater 1687, the Remainder will be 115, and ſo many Years are paſs'd ſince the making of the ſaid Things, as by the Work in the Margent.

1687
1572
115

Queſt. 4. There are three Towns lie in a ſtraight Line, *viz. London*, *Huntington* and *York*, now the Diſtance between the fartheſt of theſe Towns, *viz. London* and *York*, is 151 Miles, and from *London* to *Huntington* is 49 Miles, I demand how far it is from *Huntington* to *York?*

The

To reſolve this Queſtion, ſubtract 49 the Diſtance between *London* and *Huntington*, from 151 the Diſtance between *London* and *York*, and the Remainder is, 102 for the true Diſtance between *Huntington* and *York*. See the Work in the Margent.

151
49
———
102

CHAP. VI.

Of Multiplication of Whole Numbers.

1. MULTIPLICATION is perform'd by two Numbers of like Kind for the production of a third, which ſhall have ſuch Reaſon to the one, as the other hath to the Unit, and in Effect is a moſt brief and artificial *Compound Addition* of many equal Numbers of like Kind into one Sum. Or, *Multiplication* is that by which we multiply two or more Numbers, the one into the other, to the End that their Product may come forth, or be diſcover'd.

Or, *Multiplication* is the increaſing of any one Number by another, ſo often as there are Units in that Number, by which the other is increaſed, or by having two Numbers given to find a third, which ſhall contain one of the Numbers as many times as there are Units in the other.

2. *Multiplication* hath three parts. Firſt, The Multiplicand or Number to be multiply'd. Secondly, The Multiplier or Number given by which the Multiplicand is to be multiply'd. And thirdly, The Product or Number produc'd by the other two, the one being multiply'd by the other, as if 8 were given to be multiply'd by 4, I ſay, 4 times 8 is 32; here 8 is the Multiplicand, and 4 is the Multiplier, and 32 is the Product.

8
4
——
32

3. *Multiplication* is either *Single*, by one Figure; or *Compound*, that conſiſts of many.

Single Multiplication is ſaid to conſiſt of one Figure, becauſe the Multiplicand and Multiplier conſiſt each of them of a Digit, and no more; ſo that the greateſt Product that can ariſe by *Single Multiplication*, is 81, being the ſquare of 9; and *Compound Multiplication*, is ſaid to conſiſt of many Figures, becauſe the Multiplicand or Multiplier conſiſts of more places than one; as if I were to multiply 436 by 6: It is call'd *Compound*, becauſe the Multiplicand 436 is of more places than one, *viz.* 3 places.

4. The Learner ought to have all the Varieties of *Single Multiplication* by Heart, before he can well proceed any farther in this Art, it being of moſt excellent Uſe, and none of the following Rules in *Arithmetick*, but what have a principal Dependance thereupon, which may be learnt by the following Table.

Multiplication TABLE.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The Uſe of the precedent Table is this; In the uppermoſt Line or Column you have expreſſed all the Digits from 1 to 9; and likewiſe Beginning at 1 and going downwards in the ſide Column, you have the ſame; ſo that if you would know the Product o

a

and two ſingle Numbers multiply'd by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your Eye from each Figure along the reſpective Columns, in the common Angle (or place) where theſe two Columns meet, there is the Product required. As for Example, I would know how much is 8 times 7; Firſt I look for 8 in the uppermoſt Column, and 7 in the ſide Column; then do I caſt my Eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my Eye from thence toward the Right-hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required; it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide; the like is to be underſtood of any other ſuch Numbers. The Learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the Multiplicand conſiſts of many places, and the Multiplier of but one Figure; firſt ſet down the Multiplicand and under it place the Multiplier in the place of Units, and draw a Line underneath them; then begin and multiply the Multiplier into every particular Figure of the Multiplicand, beginning at the Place of Units, and ſo proceed towards the Left-hand, ſetting each particular Product under the Line, in order as you proceed: But if any of the products exceed 10, or any Number of Tens, ſet down the Exceſs and for every 10 carry a Unit to be added to the next product, always remembring to ſet down the Total Product of the laſt Figure. which Work being finiſh'd, the Sum or Number placed under the Line ſhall be the true and total product required. As for Example, I would multiply 478 by 6. Firſt I ſet down 478, and underneath it 6 in the place of Units, and draw a Line underneath them, as in the Margent; then I begin, ſaying, 6 times 8 is 48, which is 8 above Four Tens, therefore I ſet down 8 (the Exceſs), and bear 4 in mind for the

$$\begin{array}{r} 478 \\ 6 \\ \hline 2868 \end{array}$$

4 Tens; then I proceed, ſaying, 6 times 7 is 42 and 4 that I carry'd is 46, I then ſet down 6 and carry 4, and go on ſaying, 6 times 4 is 24, and 4 that I carry'd is 28, and becauſe it is the laſt Figure, I ſet it all down, and ſo the Work is finiſhed, and the Product is found to be 2868, as was required.

6. When in *Compound Multiplication*, the Multiplier conſiſteth of divers Places, then begin with the Figure in the place of Units in the Multiplier, and multiply it into all the Figures in the multiplicand placeing the product below the Line, as was directed in the laſt Example; then begin with the Figure of the ſecond place of the Multipliert (*viz.*) the place of Tens, and multiply it likewiſe into the whole Multiplicand (as you did the firſt Figure) placing its Product under the Product of the firſt Figure; do in the ſame manner by the Third, Fourth, and Fifth, *&c.* until you have multiply'd all the Figures of the Multiplier particularly into the whole Multiplicand, ſtill placing the Product of each particular Figure under the Product of its precedent Figure; herein obſerving the following Caution.

A Caution.

In the placing of the Product of each particular Figure of the multiplier, you are not to follow the 2d Rule of the 4th Chapter, *viz.* to place Units under Units, and Tens under Tens, *&c.* but to put the Figure or Cypher in the place of Units of the ſecond Line under the ſecond Figure or place of Tens in the Line above is, and the Figure or Cypher in the place of Units of the third Line under the place of Tens in the ſecond Line, *&c.* obſerving this Order till you have finiſhed the Work, ſtill placing the firſt Figure of every Line or Product under the ſecond Figure or place of Tens in that which was above it, and having ſo done draw a Line under all theſe particular Products, and add them together; ſo ſhall the Sum of all theſe Products be the Total Product required.

As if it were required to multiply 764 by 27, I ſet them down the one under the other; with a Line drawn under underneath them; then I begin, ſaying, 7 times 4 is 28, then I ſet down 8 and carry 2; then I ſay, 7 times 6 is 42, and 2 that I carred is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I ſet down, becauſe I have not another Figure to multiply; thus I have done with the 7, then I begin with the 2, ſaying, 2 times 4 is 8, which I ſet down under (4) the ſecond Figure or place of Tens in the Line above it, as you may ſee in the Margent; then I proceed, ſaying, 2 times 6 is 12, that is 2 and carry one, then 2 times 7 is 14, and 1 that I carry, is 15, which I ſet down becauſe 'tis the product of the laſt Figure; ſo that the product of 764 by 7 is 5348, and by 2 is 1528, which being placed the one under the other, as is before directed, as you ſee in the Margent, and a Line drawn under them, and they added together reſpectively, make 20628, the true product required, being equal to 27 times 764.

$$\begin{array}{r} 764 \\ 27 \\ \hline 5348 \\ 1528 \\ \hline 20628 \end{array}$$

Another Example may be this; Let it be required to multiply 5486 by 465, I diſpoſe of the Multiplicand and Multiplier, according to the Rule, and begin multiplying the firſt Figure of the Multiplier, which is (5) into the whole Multiplicand, and find the product is, 27430; then I proceed, and multiply the ſecond Figure (6) of the Multiplier into the Multiplicand, and find the product to amount to 32916, which is ſubſcribed under the other product reſpectively; then do I multiply the third and laſt Figure (4) of the Multiplier into the Multiplicand, and the product is 21944, which is likewiſe placed under the ſecond Line reſpectively; then I draw a Line under the ſaid products (being placed the one under the other according to Rule, and add them together, and the Sum is 2550990, the true product ſought, being equal to 5486 times 465, or 465 times 5486.

$$\begin{array}{r} 5486 \\ 465 \\ \hline 27430 \\ 32916 \\ 21944 \\ \hline 2550990 \\ \hline \end{array}$$

More Examples in this Rule are theſe following.

430865
4739
———
3877785
1292595
3016055
1723460
———
2041869235

6400758
37496
———
38404548
57606822
25603032
44805306
19202274
———
240002821968

Compendium in Multiplication.

7. Although the former Rules are ſufficient for all Caſes in *Multiplication*, yet becauſe in the Work of *Multiplication* many times great Labour may be ſaved, I ſhall acquaint the Learner with ſome Compendiums in order thereto. *viz.* If the Multiplicand or Multiplier or both of them end with Cyphers, then in your multiplying you may neglect the Cyphers, and multiply only the ſignificant Figures, and to the Product of thoſe ſignificant Figures, add ſo many Cyphers as the Numbers given to be multiply'd did end with; that is, annex on the Right Hand of the ſaid Product, ſo ſhall that give you the true Product required As if I were to multiply 32000 by 4300, I ſet them down in order to be multiply'd as you ſee in the Margent, but neglecting the Cyphers in both Numbers, I only multiply 32 by 43, and the Product I find to be 1376, to which I annex the 5 Cyphers that are in the Multiplicand and Multiplier, and then it makes 137600000 for the true Product of 32000 by 4300.

Sic numeris propoſitis unus vel uterque adjunctos habeat ad dextram circulos, omiſſis circulis fiat ipſorum numerorum multiplicatio, & facto demum tot inſuper integrorum loci accenſeantur quot ſunt omiſſi circuli in utroque factore. Clavis Mat. c. 4. 3.

32000
4300
———
96
128
———
137600000

8. If in the Multiplier, Cyphers are placed between ſignificant Figures, then multiply only by the ſignificant Figures, neglecting the Cyphers, but here ſpecial Notice is to be taken of the true placing of the firſt Figure after the Neglect of ſuch Cypher or Cyphers; and therefore you muſt obſerve in what place of the Multiplier the Figure you multiply by ſtandeth, and ſet the firſt Figure of that Product under the ſame place of the Product of the firſt Figure of your Multiplier: As for Example, let it be requir'd to multiply 371568 by 40007. Firſt, I multiply the Multiplicand by 7, and the Product is 2600976, then neglecting the Cyphers I multiply by 4, and that Product is 1486272; now I conſider, that 4 is the fifth Figure in the Multiplier, therefore I place 2 (the firſt Figure of the Product by 4) unper the fifth place of the firſt Product by 7, and the reſt in order, and having added them together, the total Product is found to be 14865320976. Other Examples in this Rule, are theſe following:

Si intermedio multiplicantis loco circulus fuerit, iſte negligitur. Alſted. cap. 6. *De Arithm.*

```
     371568
      40007
   --------
    2600976
1486272
-----------
14865320976
```

```
   327586
     6030
 --------
  9827580
1965516
----------
1975343480
```

```
   7864371
     20604
 ---------
  31457484
 47186226
15728742
------------
162037500084
```

9. If you are to multiply any Number by an Unit with Cyphers (*viz.*) by 10, 100, 1000, *&c.* then annex ſo many Cyphers before the Multiplicand, and that number when the Cyphers are annex'd is the Product required, if you would multiply 428 by 100, annex two Cyphers to 428, and it is 42800. If it were required

requir'd to multiply 102 by 10000, annex 4 Cyphers, and it gives 1020000 for the product requir'd.

The Proof of Multiplication.

10. *Multiplication* is proved by *Diviſion* and, to ſpeak truth, all other Ways are falſe; and therefore it will be moſt convenient in the firſt place to learn *Diviſion*, and by that to prove *Multiplication*. There is a Way (at this Day generally uſed in Schools) to prove *Multiplication*, which is this; Firſt add all the Figures in the Multiplicand together, as if they were Simple Numbers, caſting away the Nines as oft as it comes to ſo much, noting the Remainder at laſt, which in this Caſe cannot be ſo much as 9: Caſt likewiſe the Nines out of the Multiplier as you did out of the Multiplicand, and note the Remainder; then multiply the Remainders, one by the other, and caſt the Nines out of the Product, obſerving the Remainder; and laſtly, caſt the Nines out of the total Product and if this Remainder be equal to the Remainder laſt found, then they conclude the Work to be rightly perform'd; but there may be given a thouſand (nay infinite) falſe Products in *Multiplication*, which after this Manner may be prov'd to be true; and therefore this Way of Proving doth not deſerve any Example; but we ſhall defer the Proof of this Rule till we come to prove *Diviſion*, and then we ſhall prove them both together.

> *Neq; eſt quod aliam expectes examinandi viam; nam aliæ vulgares & falſæ ſunt, & nullo innixæ fundamento.*
> *Gemma Friſius.*

11. The general Effect of *Multiplication*, is contain'd in the Definition of the ſame, which is to find out a third Number, ſo often containing one of the two given Numbers, as the other containeth Units.

The ſecond Effect, is, by having the length and breadth of any Thing (as a Parallelogram or long Plain) to find the ſuperficial Content of the ſame, and by having the ſuperficial Content of the Baſe, and the length to find out the Solidity of any Parallelopipedon, Cylinder, or other ſolid Figures.

The third Effect is, by the Contents, Price, Value, Buying, Selling, Expence, Wages, Exchange, Simple Intereſt, Gain or Loſs of any one Thing, be it Money, Merchandize, *&c.* to find out the Value, Price, Expence, Buying, Selling, Exchange or Intereſt of any number of Things of like Name, Nature and Kind.

The fourth Effect (is not much unlike the other) by the Contents, Value, or Price of any one Part of any Thing denominated, to find out the Contents, Value, or Price of the whole Thing, all the Parts into which the whole is divided, multiplying the Price of one of thoſe Parts.

The fifth Effect is, to aid, to compound, and to make other Rules, as chiefly, the Rule of Proportion, call'd the *Golden Rule*, or *Rule of Three*; alſo by it, Things of one Denomination are reduc'd to another.

If you multiply any number of Integers, or the Price of the Integer, the Product will diſcover the Price of the Quantity, or number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Baſe by the depth, and that produce by the length, this laſt Product will diſcover the Solidity or Content of the ſame Solid.

Some Queſtions proper to this Rule, may be theſe following.

Queſt. 1. What is the Content of a ſquare Piece of Ground, whoſe length is 28 Perches, and breadth 13 Perches?

Anſwer, 364 ſquare Perches; for multiplying 28 the length, by 13 the breadth, the Product is ſo much.

Queſt. 2 There is a ſquare Battle whoſe Flank is 47 Men, and the Files 19 deep, what number of Men doth that Battle contain? *Facit,* 893; for multiplying 47 by 19, the Product is 893.

Queſt. 3. If any one Thing coſt 4 Shillings, what ſhall 9 Things coſt? *Anſw.* 36 Shillings; for multiplying 4 by 9, the Product is 36.

Queſt. 4. If a Piece of Money or Merchandize be worth or coſt 17 Shillings, what ſhall 19 ſuch Pieces of Money or Merchandize coſt? *Facit*, 323 Shillings, which is equal to 16 *l.* 3 *s.*

Queſt. 5. If a Soldier or Servant get or ſpend 14 *s. per* Month, what is the Wages or Charges of 49 Soldiers or Servants for the ſame Time? Multiply 49 by 14, the Product is 686 *s.* or 34 *l.* 6 *s.* for the *Anſwer.*

Queſt. 6. If in a Day there are 24 Hours, how many Hours are there in a Year, accounting 365 Days to conſtitute the Year? *Facit*, 8760 Hours; to which if you add the 6 Hours over and above 365 Days, as there is in a Year. then it will be 8766 Hours; now if you multiply this 8766 by 60, the number of Minutes in an Hour, it will produce 525960 the number of Minutes in a Year.

CHAP. V.

Of Diviſion of Whole Numbers.

DIVISION, is the ſeparating or parting of any Number or Quantity given into any Parts aſſign'd, or to find how often one Number is contain'd in another; or from any two Numbers given, to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is comprehended or contained in the other.

2. *Diviſion* hath three Parts or Numbers remarkable, *viz.* Firſt the Dividend. Secondly, the Diviſor. Thirdly, the Quotient. The Dividend is the Number given to be parted or divided. The Diviſor is the Number given, by which the Dividend is divided, or it is the Number which ſheweth how many Parts the Dividend is to be divided into. And the Quotient is the Number produc'd by the diviſion of the two given Numbers the one by the other.

So 12 being given to be divided by 3, or into three equal Parts, the Quotient will be 4, for 3 is contain'd in 12 four times, where 12 is the Dividend, and 3 is the Diviſor, and 4 is the Quotient.

3. In *Diviſion* ſet down your Dividend, and draw a crooked Line at each end of it, and before the Line at the Left-hand place the Diviſor, and behind that on the Right-hand place the Figures of the Quotient, as in the Margent, where it is requir'd to divide 12 by 3: Firſt, I ſet down 12 the Dividend, and on each ſide of it, do I draw a crooked Line, and before that on the Left-Hand do I place 3 the Diviſor; then do I ſeek how often 3 is contain'd in 12; and becauſe I find it 4 times, I put 4 behind the crooked Line, on the Right-hand of the Dividend, denoting the Quotient.

3) 12 (4

4. But if when the Diviſor is a ſingle Figure, the Dividend conſiſteth of two or more places, then having placed them for the Work (as is before directed) put a Point under the firſt Figure on the Left-hand of the Dividend, provided it be bigger than (or equal to) the Diviſor, but if it be leſſer than the Diviſor, then put a Point under the ſecond Figure from the Left-hand of the Dividend; which Figures as far as the Point goeth from the Left-hand, are to be reckon'd by themſelves, as if they had no dependance upon the other part of the Dividend, and for Diſtinction ſake may be call'd the Dividual; then ask how often the Diviſor is contain'd in the Dividual; placing the Anſwer in the Quotient; then multiply the Diviſor by the Figure that you placed in the Quotient, and ſet the Product thereof under your Dividual; then draw a Line under the Product, and ſubſtract the ſaid Product from the Dividual placing the Remainder under the ſaid Line; then put a Point under the next Figure in the Dividend on the Right-hand of that to which you put the Point before, and draw it down, placing it on the Right-hand of the Remainder which you found by *Subſtraction*; which Remainder, with the ſaid Figure annexed before it, ſhall be a new Dividual; then ſeek again how often the Diviſor is contain'd in this new Dividual. and put the Anſwer in the Quotient on the Right-hand of the Figure which you put there before; then multiply the Diviſor by the laſt Figure that you

put in the Quotient, and ſubſcribe the Product under the Dividual, and make Subſtraction, and to the Remainder draw down the next Figure from the grand Dividend, (having firſt put a Point under it) and put it on the Right-hand of the Remainder for a new Dividual as before, *&c.* and proceed thus till the Work is finiſhed.

Obſerving this general Rule in all Kinds of Diviſion.

Firſt, To ſeek how often the Diviſor is contained in the Dividual; then (having put the Anſwer in the Quotient) multiply the Diviſor thereby, and ſubſtract the Product from the Dividual. An Example or two will make the Rule plain. Let it be required to divide 2184 by 6. I diſpoſe of the Numbers given as is before directed, and as you ſee in the Margent, in order to the Work, then (becauſe 6 the Diviſor is more than 2 the firſt Figure of the Dividend) I put a Point under 1 the ſecond Figure, which makes 21 for the Dividual, then do I aſk how often 6 the Diviſor is contained in 21, and becauſe I cannot have it more than three times, I put 3 in the quotient, and thereby do I multiply the Diviſor (6) and the *Product*, is 18, which I ſet in order under the Dividual, and ſubſtract it therefrom, and the Remainder (3) I place in order under the Line, as you ſee in the Margent.

```
6) 2184(6
    .
```

```
6) 2184(3
    .
   18
  ----
    3
```

Then do I make a Point under the next Figure of the Dividend being 8, and draw it down, placing it before the Remainder 3, ſo have I 38 for a new Dividual, then do I ſeek how often 6 is contained in 38, and becauſe I cannot have it more then 6 times I put 6 in the quotient, and thereby do I multiply the Diviſor 6, and the Product (36) I put under the Dividual (38) and ſubſtract it therefrom, and the Remainder 2 I put under the Line as you ſee in the Margent.

```
6)2184(36
   ..
   18
   ----
    38
    36
   ----
     2
```

Then do I put a point under the next (and laſt) Figure of the Dividend (being 4) and draw it down to the Remainder 2, and putting it on the right Hand thereof, it maketh 24 for a new Dividual; then I ſeek how often 6 is contained in 24, and the Anſwer is 4, which I put in the Quotient, and multiply the Diviſor (6) thereby, and the Product (24) I put under the dividual (24) and ſubtract it therefrom, and the Remainder is (0); and thus the Work is finiſh'd, and I find the Quotient to be 364, that is 6 is contain'd in 2184 juſt 364 times, or 2184 being divided into 6 equal parts, 364 is one of thoſe parts.

```
6)2184(364
   ...
  18
  ----
   38
   36
   ----
    24
    24
   ----
   (0)
```

Again, if it were requir'd to divide 2646 by 7, or into 7 equal Parts, the Quotient will be found to be 378, as by the following.

```
7) 2646 (378
    ...
    21
  -------
    54
    49
  -------
     56
     56
  -------
    00
```

So if it were required to divide 946 by 8, the Quotient will be found to be 118, and 2 remaining after diviſion is ended. The Work followeth.

8) 946 (118
8
14
8
66
64
(2)

Many times the Dividend cannot exactly be divided by the Diviſor, but ſomething will remain, as in the laſt Example, where 946 was given to be divided by 8, the Quotient was 118, and there remaineth 2 after the Diviſion is ended; Now what is to be done in this Caſe with the Remainder, the Learner ſhall be taught when we come to treat of the reducing (or Reduction) of Fractions.

And here note, that if after your diviſion is ended, any thing do remain, it muſt be leſſer then your diviſor, for otherwiſe your Work is not rightly perform'd.

Other Example are ſuch as follow.

8) 73464 (9083
72
14
8
66
64
24
24
(0)

9) 13758 (1528
9
47
45
25
18
78
72
(5)

5. But if the Diviſor conſiſteth of more places than one, then chooſe ſo many Figures from the Left-ſide of the Dividend for a Dividual as there are Figures in the Diviſor, and put a Point under the fartheſt Figure of that Dividual to the Right-hand, and ſeek how often the firſt Figure on the Left-ſide of the Diviſor is contained in the firſt Figure on the Left-ſide of the Dividual, and place the Anſwer in the Quotient, and thereby multiply your Diviſor, placing your Product under your Dividual, and ſubtract it therefrom, placing the Remainder below the Line; then put a Point under the next Figure in the Dividend, and draw it down to the ſaid Remainder, and annex it on the Right ſide thereof, which makes a new Dividual, and proceed as before, till the Work is finiſhed.

And if it ſo happen that after you have choſen your firſt Dividual, (as is before directed) you find it to be leſſer than the Diviſor, then put a Point under the Figure more near to the Right-hand, and ſeek how often the firſt Figure on the Left-ſide of the Diviſor, is contained in the two firſt Figures on the Left-ſide of the Dividual, and place the Anſwer in the quotient, by which multiply the Diviſor, and place the Product thereof in order under the Dividual, and ſubtract it therefrom, and proceed as before.

Always remembring, (that in all Caſes of Diviſion) if after you have multiply'd your Diviſor by the Figure firſt placed in the quotient, if the Product be greater than the Dividual, then you muſt cancel that Figure in the quotient, and inſtead thereof put a Figure leſſer by an Unit (or one) and multiply the Diviſor thereby, and if ſtill the Product be greater than the Dividual, make the Figure in the quotient yet leſſer by an Unit, and thus do until your product be leſſer than the Dividual or at the moſt equal thereto, and then make Subſtraction, *&c.*

So if you would divide 9464 by 24, the quotient will be found to be 394; I firſt put down the given Number as is before directed in the third Rule; Now becauſe my diviſor conſiſteth of two Figures,I therefore put a Point under the ſecond Figure from the left hand of my Dividend, which there is 4, wherefore I ſeek how often 2 the firſt Figure(on the left ſide of the Diviſor) is contained in 9 (the like firſt in the Dividual) the Anſwer is 4, which I put in the quotient and thereby multiply all the Diviſor, and find the Product to be 96 which is greater then the Dividual 94, wherefore I cancel the 4 in the quotient, and inſtead therefore I put 3 (an Unit leſſer) and by it multiply the Diviſor 24 and the Product is 72; which I ſubſtract from 94 the Dividual, and the Remainder is 22, then do I make a point under the next figure 6 in the Dividend, and draw it down and place it on the right ſide of the remainder 22, and it makes 226 for a new Dividual, now becauſe the Dividual 226 conſiſteth of a Figure more than the Diviſor, therefore I ſeek how often 2 (the firſt Figure of the Diviſor) is contained in 22, the two firſt of the Dividual, I ſay 9 times, wherefore I put the 9 in the quotient, and thereby multiply the Diviſor 24, the Product (216) I place under the Dividual 226, and ſubſtract it from it, and there remaineth 10.

```
            (3
24)  9464  (
      ...   (4
      72
     ----
      22
```

```
24)  9464  (39
      ..
      72
     ----
      226
      216
     -----
       10
```

Then I go on and make a point under the next and laſt Figure (4) in the Dividend, and draw it down to the remainder 10, and it maketh 104 for a new Dividual,which is alſo a Figure more than the Diviſor; and therefore I ſeek how often 2 is contain'd in 10, I anſwer 5 times; but multiplying my Diviſor by 5, the Product is 120, which is greater than the Diviſor, and therefore I make it but 4 and by it multiply the Diviſor, and the Product is 96, which being placed under, and ſubſtracted from the Dividual, there remainth 8, and thus the whole Work of this Diviſion is ended, and I find that 9464 being divided by 24.

or into 24 equal parts, is found to be 394, as was ſaid before, and the Remainder is 8, as you ſee in the Work following.

24) 9464 (394
72
226
216
104
96
(8)

Another Example may be this: Let there be requir'd the Quotient of 1183653 divided by 358; firſt I diſpoſe of the Numbers in order to their dividing, and becauſe 118 the three firſt Figures of the Dividend is leſſer than the Diviſor 385. I therefore make a Point under the fourth Figure, which is 3, and ſee how often 3 (the firſt Figure of the Diviſor) is contain'd in 11: The Anſwer is 3, which I put in the Quotient, and thereby multiply the Diviſor 385, and the Product is 1155, which I ſubtract from the Dividual 1183, and there remains 28. Then (as before) I draw down the next Figure, which is 6, and place it before the Remainder 28; ſo have I 286 for a new Dividual, and becauſe it hath no more Figures than the Diviſor, I ſeek how often 3 (the firſt Figure in the Diviſor) is contain'd in 2 (the firſt Figure of the Dividual) and the Anſwer is 0; for a greater Number cannot be contain'd in a leſſer, wherefore I put 0 in the Quotient, and thereby (according to the 5th Rule) I ſhould multiply my Diviſor, but if I do, the Product will be 0, and

385) 1183653 (3
1155
28

385) 1183653 (30
1153
286

nd o ſubtracted from the Dividual 286, the Remainder s the ſame, wherefore I draw own the next Figure (5) from he Dividend, and put it before he ſaid Remainder 286, ſo have 2865 for a new Dividual; and ecauſe it conſiſteth of four places, *viz.* a place more than the Diviſor, I ſeek how often 3 (the irſt figure of the Diviſor) is contain'd in 28 (the two firſt of the Dividual) and I ſay, there is 9 times 3 in 28, but multiplying my whole Diviſor (385) thereby, I find the Product to be 3465, which is greater then the Dividual 2865, wherefore I chuſe 8, which is leſſer by an Unit than 9, and thereby I multiply my Diviſor 385, and the Product is 3080. which ſtill is greater than the ſaid Dividual, wherefore I chuſe another Number yet an Unit leſſer, *viz.* 7, and having multiply'd my Diviſor thereby, the Product is 2695, which is leſſer than the Dividual 2865, wherefore I put 7 in the Quotient, and ſubtract 2695 from the Dividual 2865, and there remains 170; then I draw down the laſt Figure (3) in the Dividend, and place it before the ſaid Remainder 170, and it makes 1703 for a new Dividual; then for the Reaſon above-ſaid) I ſeek how often 3 is contain'd in 17, the Anſwer is 5, but multiplying the Diviſor thereby, the product is 1925, greater than the Dividual, wherefore I ſay it will bear 4 (an Unit leſſer) and by it I multiply the Diviſor 385, and the Product is 1540, which is leſſer than the Dividual, and therefore I put 4 in the Quotient, and ſubtract the ſaid Product from the Dividual, and there remaineth 163, and thus the Work is finiſhed; and I find that 1183653 being divided by 385,

```
385) 1183653 (307
       ...
     1155
    ------
      2865
      2695
     ------
       170
```

```
385) 1183653 (3074
       ....
     1155
    -------
      2865
      2695
     ------
      1703
      1540
     ------
     (163)
```

or into 385 equal Shares or Parts, (the Quotient or one of thoſe Parts,) is 3074, and beſides there is 163 remaining.

And thus the Learner being well-vers'd in the Method of the fore-going Examples, he may be ſufficiently qualify'd for the dividing of any greater Sum or Number into as many Parts as he pleaſeth, that is, he may underſtand the Method of dividing by a Diviſor, which conſiſteth of 4, or 5, or 6, or any greater Number of Places, the Method being the ſame with the forgoing Examples in every reſpect.

Other Examples in Diviſion.

27986) 835684790 (29860
• • • •
55972
275964
251874
240907
223888
170199
167916
Remains (22830)

196374) 473986018 (2413
• • • •
292748
812380
785496
268841
1966374
724678
589122
Remains (135556)

So if you divide 47386473 by 58736 you will find the Quotient to be 806, and 45257 will remain after the Work is ended.

In like manner if you would divide 3846739204 by 483064, the Quotient will be 7963, and the Remainder after Diviſion will be 100572.

Compendiums in Diviſion.

1. IF any given Number be to be divided by another Number that hath Cyphers annexed on the Right-ſide thereof, (omitting the Cyphers) you may cut off ſo many figures from the right-hand of the dividend, as there are Cyphers before the diviſor, and let the remaining Numbers in the dividend, be divided by the remaining number or numbers of the diviſor, obſerving this Caution, that if after your Diviſion is ended any thing remain, you are to annex thereto the Number or Numbers that were cut off from the dividend; and ſuch new found Number ſhall be the Remainder. As for Example; Let it be required to divide 46658 by 400, now becauſe there are 2 Cyphers before the Diviſor, I cut off as many Figures from before the dividend, *viz.* 58 ſo that then there will remain only 466 to be divided by 4, and the Quotient will be 116, and there will remain 2, to which I annex the two Figures (58) which were cut off from the dividend, and it makes 258 for the true Remainder; ſo that I conclude 46658 being divided by 400, the quotient will be 116 and 258 remained after the Work is ended; as by the Work in the Margin.

Et ſi Diviſor adjunctos ſibi habeat Circulos ad dextram omiſſis circulis & abſciſſis totidem ultimis Figuris dividendi, in numeris reliquis fiat diviſio, in fine autem diviſionis reſtituendi ſunt tum omiſſi circuli tum figuræ abſciſſæ, *Ough. Cla. Matth.* cap. 5. 8.

```
4|00) 466|58 (116
      4
     ----
      6
      4
     ----
      26
      24
     ----
     (258)
```

2. And hence it followeth, that if the Diviſor be (1) or a Unit with Cyphers annexed, you may cut off ſo many Figures from before the Dividend, as there are Cyphers in the Diviſor, and then the Figure or Figures that are on the Left-hand will be the Quotient; and thoſe that are on the Right-hand will be the Remainder after the Diviſion is ended: As thus; If 45783 were to be divided by 10, I cut of the laſt Figure (3) with a daſh thus, (4578|3) and the Work is done, and the Quotient is 4578 (the Number on the Left-hand of the daſh) and the Remainder is 3 (on the Right-hand.) In like manner if the ſame Number 45783 were to be divided by 100, I cut off two Figures from the end thus, (457|83) and the Quotient is 457, and the Remainder is 83. And if I were to divide the ſame by 1000, I cut of 3 Figures from the end thus (45|783) and the Quotient is 45, and 783 the Remainder, *&c.*

Diviſurus quemcunque numeram per 10. *Aufer ex dextra parte unicam eamque primam figuram* Reliquæ *enim figuræ productum oſtendunt. Ablatum* Reſiduum, *&c.* Gem. Friſ. *Arith.* Part. I.

6. The general effect of *Diviſion*, is contain'd in the Definition of the ſame, (that is) by having two unequal Numbers given, to find a third Number in ſuch proportion to the Dividend, as the Diviſor hath to Unit or 1; it alſo diſcovers what Reaſon or Proportion there is between Numbers; ſo if you divide 12 by 4, it quotes 3, which ſhews the Reaſon or Proportion of 4 to 12 is triple.

The ſecond Effect is, by the ſuperficial Meaſure or Content, and the length of any Oblong, Rectangular Parallelogram, or ſquare Plane known, to find out the length thereby; or contrariwiſe, by having the ſuperficies and breadth of the ſaid Figure, to find out the breadth thereof. Alſo by having the ſolidity and length of a Solid to find the ſuperficies of the Baſe, *& contra.*

The third Effect, is, by the Contents, Reaſon, Price, Value, Bying, Selling, Expences, Wages, Exchange, Intereſt, Profit, or Loſs of any number of Things (be it Money, Merchandice, or what elſe) to find out the

Contents, Reaſon, Price, Value, Buying, Selling, Expence, Wages, Exchange, Intereſt, Profit or Loſs, or any one Thing of like Kind.

The fourth Effect is to Aid, to Compoſe and to make other Rules; but principally the *Rule of Proportion*, called the *Golden Rule*, or *Rule of Three*, and the Reduction of Monies, Weights and Meaſures of one Denomination into another; by it alſo Fractions are abbreviated by finding a Common-Meaſurer, unto the Numerator and Denominator, thereby diſcovering commenſurable Numbers.

If you divide the Value of any certain Quantity by the ſame Quantity, the Quotient diſcovers the Rate or Value of the Integer; as if 8 Yards of Cloth coſt 29 *Shillings*, if you divide (96) the Value or Price of the given Quantity, by (8) the ſame Quantity, the Quotient will be 128, which is the Price or Value of 1 of thoſe Yards, *& contra.*

If you divide the Value or Price of any unknown Quantity, by the Value of the Integer, it gives you in the Quotient that unknown Quantity, whoſe Price is thus divided; as if 12 *Shillings* were the Value of 1 Yard, I would know how many Yards are worth 96 *Shillings*; Here if you divide (96) the Price or Value of the unknown Quantity (by 12) the Rate of the Integer, or 1 Yard, the Quotient will be 8, which is the number of Yards worth 96 *Shillings.*

Some Queſtions anſwered by Diviſion may be theſe following.

Queſt. 1. If 22 things coſt 66 *Shillings*, what will 1 ſuch thing coſt? *Facit* 3 *Shillings*; for if you divide 66 by 22, the Quotient is 3 for the Anſwer ſo if 26 Yards or Ells of any thing be bought or ſold for 108 *l.* how much will 1 Yard or Ell be bought or ſold for? *Facit*, 3 *l.* for if you divide 108 *l.* by 36 Yards, the Quotient will be 3 *l.* the Price of the Integer.

Queſt. 2. If the Expence, Charges, or Wages of 7 Years amount to 868 *l.* what is the Expence, Charges, or Wages of 1 Year? *Facit*, 124 *l.* for if you divide

868 (the Wages of 7 Years) by 7 (the number of Years) the Quotient will be 124 *l.* for the Anſwer. See the Work.

```
7) 868 (124
   ...
   7
   ---
   16
   14
   ---
    28
    28
   ---
   (0)
```

Queſt. 3. If the Content of one ſuperficial Foot be 144 Inches, and the breadth of a Board be 9 Inches, how many Inches of that Board in length will make ſuch a Foot? *facit*, 16 Inches; for by dividing 144 (the number of ſquare Inches in a ſquare Foot) by 9 (the Inches in the breadth of the Board) the Quotient is 16 for the number of Inches in length of that Board to make a ſuperficial Foot.

```
9) 144 (16 Inches
   ..
   9
   ---
   54
   54
   ---
   (0)
```

Queſt. 4. If the Content of an Acre of Ground be 160 ſquare Perches, and the length of a Furlong (propounded) be 80 Perches, how many Perches will there go in breadth to make an Acre? *facit*, 2 Perches; for if you divide 160 the number of Perches in an Acre by 80 (the length of the Furlong in Perches) the Quotient is 2 Perches; and ſo many in breadth of that Furlong will make an Acre.

80) 160 (2 *Perches*
160
———
(0)

Queſt. 5. If there be 893 Men to be made up into a Battel, the Front conſiſts of 47 Men, what Number muſt there be in the File? *Facit*, 19 deep in the File; For if you divide 893 (the number of Men) by 47 (the number in the Front) the Quotient will be 19 File in depth; the Work followeth.

47) 893 (19 *deep in File*
47
———
423
423
———
(0)

Queſt. 6. There is a Table whoſe ſuperficial Content is 72 Feet, and the breadth of it at the end is 3 Feet; now I demand what is the length of this Table? *Facit*, 24 Feet long; for if you divide 72 (the Content of the Table in Feet) by 3, (the breadth of it) the Quotient is 24 Feet for the length thereof, which was required. See the Operation as followeth;

3) 72 (24
6
———
12
12
———
(0)

The Proof of Multiplication, and Diviſion.

Multiplication and *Diviſion* Interchangeably prove each other; for if you would prove a Sum in *Diviſion*, whether the Operation be right or no, multiply the *Quotient* by the *Deviſor* ; and if any thing remain after the *Diviſion* is ended, add it to the Product, which Product (if your Sum was arightly divided) will be equal to the *Dividend.* And contrariwiſe, if you would prove a Sum in *Multiplication*, divide the Product by the Multiplier, and if the work was rightly performed, the Quotient will be equal to the *Multiplicand.* See the *Example* where the Work is done and undone. Let 7654 be given to be Multiply'd by 3242, the Product will be 24814268, as by the Work appeareth.

```
      7654
      3242
    ------
     15308
    30616
   15308
  22962
  --------
  24814268
```

And then if you divide the ſaid Product 24814268 by 3242 the *Multiplier*, the *Quotient* will be 7654 equal to the given *Multiplicand.*

```
3242) 24814268 (7654
          ....
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
          (0)
```

In lik manner (to prove a Sum or Number in *Diviſion*) 24814268 were divided by 3242 the Quotient will be found to be 7654; then for *Proof*, if you multiply 7654 the Quotient, by 3242 the Diviſor, the Product will amount to 24814268, equal to the Dividend.

Or you may prove the laſt, or any other Example in *Multiplication* thus, *viz.* divide the Product by the Multiplicand, and the Quotient will be equal to the Multiplier. See the Work.

7654
3242

15308
30616
15308
22962

7654) 24814268 (3242
. . . .
22962

18522
15308

32146
30616

15308
15308

(0)

From whence there ariſeth this Corollary, that any Operation in *Diviſion* may be proved by *Diviſion*; for if after your *Diviſion* is ended, you divide the Dividend by the Quotient, the new Quotient thence ariſing will be equal to the Diviſor of the firſt Operation; for trial whereof, let the laſt Example be again repeated.

3242) 24814268 (7654
22694

21202
19452

17506
16210

12968
12968

(0)

For Proof whereof divide again 24814268 by the quotient 7654, and the quotient hence will be equal to the firſt *Diviſor* 3242: See the Work,

7654) 24814268 (3242
22962

18522
15308

32146
30616

15308
15308

(0)

But in proving Diviſion by Diviſion, the Learner is to obſerve this following Caution; That if after his Diviſion is ended, there be any Remainder, before you go about to prove your Work, ſubtract that Remainder out of your Dividend, and then work as in the following Example, where it is required to divide 43876 by 765, the quotient here is 57, and the Remainder is 271. See the Work following.

```
765) 43876 (57
       ..
     3825
     ----
     5626
     5355
     ----
     (271)
```

Now to prove this Work, ſubſtract the Remainder 271 out of the Dividend 43876, and there remaineth 43605 for a new Dividend to be divided by the former Quotient 57, and the Quotient thence ariſing is 765 equal to the given Diviſor, which proveth the Operation to be right.

```
     43876
       271
   -------
57) 43605 (765
     ...
     399
     ---
      370
      342
      ---
       285
       285
       ---
       (0)
```

Thus have we gone through the four Species of *Arithmetick*, viz. *Addition*, *Subtraction*, *Multiplication* and *Diviſion*, upon which all the following Rules, and all other Operations whatſoever that are poſſible to be wrought by Numbers, have their immediate dependance, and by them are reſolv'd. Therefore before the Learner make a farther Step in this Art, let him be well-acquainted with what hath been deliver'd in the fore-going Chapters.

Hæ ſunt igitur quatuor illæ ſpecies Arithmetices per quas omnia quæcunque deinceps dicenda ſunt, vel quæ per numeros fieri poſſibile eſt, abſolvuntur. Quare eas quiſquis es ante omnia perdiſces. Gem. Friſ. *Arith. par.* 1.

CHAP.

CHAP. VIII.

Of Reduction.

1. REDUCTION, is that which brings together two or more Numbers of different Denominations into one Denomination, or it ſerveth to change or alter Numbers, Money, Weight, Meaſure of Time, from one Denomination to another; and likewiſe to abridge Fractions to the loweſt Terms. All which it doth ſo preciſely, that the firſt Proportion remaineth without the leaſt jot of Error or Wrong committed; ſo that it belongeth as well to Fractions as Integers; of which in its proper Place. *Reduction* is generally perform'd either by *Multiplication* or *Diviſion*; from whence we may gather, That

Hill's Arith. c. 13. p. 152.

2. *Reduction*, is either deſcending or aſcending.

3. *Reduction* deſcending, is when it is requir'd to reduce a Sum or Number of a greater Denomination, into a leſſer; which Number when it is ſo reduc'd, ſhall be equal in Value to the Number firſt given in the greater Denomination; as if it were requir'd to know how many *Shillings*, *Pence*, or *Farthings*, are equal in value to an hundred *Pounds*? Or, how many Ounces are contain'd in 45 Hundred Weight? Or, how many Days, Hours or Minutes, there are in 240 Years, &c. And this kind of *Reduction* is generally perform'd by *Multiplication*.

Wing. Arith. c. 7. 2, 3, 4.

4. *Reduction* aſcending is, when it is requir'd to reduce or bring a Sum or Number of a ſmaller Denomination into a greater, which ſhall be equivalent to the given Number; as ſupoſe it were requir'd to find out how many *Pence*, *Shillings*, or *Pounds*, are equal in Value to 43785 *Farthings*? Or, how many Hundreds are equal to (or in) 3748 *Pounds*, &c. and this kind of *Reduction* is always perform'd by *Diviſion*.

5. When any Sum or Number is given to be reduc'd into another Denomination, you are to conſider whether

her it ought to be reſolv'd by the Rule deſcending or ſcending, *viz.* by *Multiplication*, or *Diviſion*; if it be o be perform'd by *Multiplication*, conſider how many arts of the Denomination into which you would re-uce it, are contained in an Unit or Integer of the iven Number, and multiply the ſaid given Number hereby, and the Product thereof will be the Anſwer o the Queſtion. As if the Queſtion were in 38 Pounds, how many Shillings? Here I conſider, that in 1 Pound are 20 Shillings, and that the Number of Shillings in 38 Pounds, will be 20 times 38, wherefore I multiply 38 *l.* by 20, and the Product is 760, and ſo many Shillings are contain'd in 38 Pounds, as in the Margin.

38
20
———
760

But when there is a Denomination, or Denominations between the Number given and the Number required, you may (if you pleaſe) reduce it into the next inferior Denomination, and then into the next lower than that, *&c.* untill you have brought it into the Denomination required. As for Example, let it be demanded in 132 *Pounds* how many *Farthings*? Firſt, I multiply 132 (the Number of *Pounds* given) by 20 to bring it into *Shillings*, and it makes 2640 *Shillings*, then do I multiply the *Shillings* 2640 by 12, to bring them into *Pence*, and it produceth 31680, and ſo many *Pence* are contain'd in 2640 *Shillings*, or 132 *Pounds*, then do I multiply the *Pence*, *viz* 31680 by 4 to bring them into *Farthings*, (becauſe 4 *Farthings* is a *Penny*) and I find the Product thereof to be 126720 and ſo many *Farthings* are equal in value to 132 *Pounds* the Work is manifeſt in the Margent.

132 *Pounds.*
20
———
2640 *Shillings.*
12
———
5280
2640
———
31680 *Pence.*
4
———
126720 *Farth.*

6. And if the Number propounded to be reduced is to be divided, or wrought by the Rule aſcending,

conſider how many of the given Numbers are equal to an Unit or Integer in that denomination to which you would reduce your given Number, and make that your Diviſor, and the given Number your Dividend; and the quotient thence ariſing will be the Number ſought or required; As for Example. Let it be required to reduce 2640 *Shillings* into *Pounds.* Here I conſider that 20 *Skillings* are equal to one *Pound*; wherefore I divide 2640 (the given Number) by 20 and the quotient is 132, and ſo many *Pounds* are contained in 2640 *Shillings.* In Reduction deſcending and aſcending the Learner is adviſed to take particular Notice of the Tables delivered in the ſecond Chapter of this Book, where he may be informed what Multipliers or Diviſors to make uſe of in the reducing of any Number to any other denomination whatſoever, eſpecially *Engliſh* Moneys, Weights, Meaſures, Time and Motion; but in this place it is not convenient to meddle with Foreign Coins, Weights or Meaſures.

```
              l.
2|0)  264|0  (132
       ..
       2
      -----
       6
       6
      ----- -
       4
       4
      ----- -
      (0)
```

But if in Reduction aſcending it happen that there is a denomination or denominations between the Number given and the Number required, then you may reduce your Number given into the next ſuperior denomination, and when it is ſo reduced, bring it into the next above that, and ſo on until you have brought it into the denomination required. As for Example,

Let it be demanded, in 126720 *Farthings* how many *Pounds*? firſt I divide my given Number (being *Farthings* by 4 to bring them into *Pence* (becauſe 4 *Farthings* make one *Penny*) and there are 31680 *Pence,* then I divide 31680 *Pence* by 12, and the quotient giveth 3640 *Shillings,* and then I divide 3640 *Shillings* by 20 and the quotient giveth 132 *Pounds,* which are equal in Value to 126720 *Farthings.* See the whole Work as it followeth.

```
          12)     2|0)     l.
4) 126720 (31680 (2640 (132
   .....   ...    ..
   12      24     2
   ---     ---    ---
    6       76     6
    4       72     6
   ---     ---    ---
    27      48     4
    24      48     4
   ---     ---    ---
     32    (0)    (0)
     32
    ---
    (0)
```

7. When the Number given to be reduc'd, conſiſteth of divers Denominations, as *Pounds*, *Shillings*, *Pence* and *Farthings*, or of *Hundreds*, *Quarters*, *Pounds* and *Ounces*, &c. then you are to reduce the higheſt (or greateſt) Denomination into the next inferior, and add thereunto the Number ſtating in that Denomination, which your greateſt or higheſt Number is reduc'd to; then reduce that Sum into the next inferior Denomination; adding thereto the Number ſtanding in that Denomination; do ſo until you have brought the Number given into the Denomination propos'd. As if it were requir'd to reduce 48 *l.* 13 *s.* 10*d.* into *Pence*; firſt I bring 48*l.* into *Shillings*, by multiplying it by 20, and the Product is 960 *Shillings*; to which I add the 13 *Shillings*, and they make 973, then I multiply 973 by 12, to bring the *Shillings* into *Pence*, and they make 11676 *Pence* to which I add the 10 *Pence* and they make 11686 *Pence*, for the Anſwer. See the Work done.

l. *s.* *d.*
48 — 13 — 10
20

960 *Shillings*
Add 13

Sum 973 *Shillings*
12

1946
973

11676 *Pence*
Add 10

Sum 11686 *Penoe*

8. If in Reduction aſcending, after Diviſion is ended, any thing remain, ſuch Remainder is of the ſame denomination with the Dividend.

Example, In 4783 *Fathings*, I demand how many *Pounds?*

Firſt, I divide the given Number of *Farthings*, *viz.* (4783) by 4 to bring them into *Pence*, and the Quotients 1195 *Pence*, and there remaineth 3 after the Work of *Diviſion* is ended, which is 3 *Farthings*.

Again, I divide 1195 *Pence* (the ſaid Quotient) by 12, to reduce them into *Shillings*, and the Quotient is 99 *Shillings*, and there is a Remainder of 7, which is 7 *Pence*.

And then divide 99 *Shillings* (the laſt Quotient) by 20 to bring it into *Pounds*, and the Quotient is 4 *l.* and there remaineth 19 *Shillings*; ſo that I conclude that in 4783 (the propoſed Number of *Farthings*) there is 4 *Pound*, 19 *Shillings*, 7 *Pence*, 3 *Farthings*. View the following Operation.

```
             12)     2|0
4) 4783    (1195    9|9 (4  Pounds
   ...       ..
    4        108     8
  -----     -----  -----
    7        115    (19)    Shillings
    4        108
  -----     -----  -----
   38  rem.   (7) Pence
   36
  -----             l.  s.  d.  qrs.
   23         Facit 04  19  07  03
   20
  -----
```

Rem. (3) *Farthings*

More Examples in Reduction of Coin.

Queſt. 1. In 438 *l.* how many Shillings? *Facit*, 8760 Shillings; for by multiplying 438 by 20, the Product mounteth to ſo much. See the Work.

```
     438 Pounds
      20
   -------
Facit. 8760 Shillings
```

Queſt. 2. In 467 *l.* how many *Pence*? Firſt multiply he given Number of *Pounds* (467) by 20, to bring it nto *Shillings*, and it makes 9340 *Shillings*, then multiply the *Shillings* by 12, and it produceth 112080 *ence*, thus,

```
        467 Pounds
         20
      --------
       9340 Shillings
         12
      --------
      18680
      9340
      --------
Facit 112080 Pence.
```

Or it may be reſolved thus, *viz.* multiply the given Number of Pounds (467) by (240) the Number of Pence in a Pound, and the Product is the ſame, *viz.* 112080 Pence, as by the Operation appeareth.

467 *Pounds*
240

18680
934

Facit 112080 *Pence.*

Queſt. 3. In 3673 *l.* how many *Farthings*? Firſt multiply the given Number by 20, to bring it into Shillings, and it produceth 113460 Shillings, then multiply that Product by 12 to bring it into Pence, and it produceth 1361520 Pence; then laſtly multiply the Pence by 4, and it produceth 5446080 Farthings. See the Operation.

5673 *Pounds*
20

113460 *ſhillings*
12

226920
113460

1361520 *Pence*
4

Facit 5446080 *Farthings*

Or this Queſtion might have been thus reſolved, *viz.* multiply 5675 (the given number of Pounds) by 960 (the number of Farthings in a Pound) and it produceth the ſame Effect, as you may ſee by the Work.

5673 *Pounds*
960

340380 *Shillings*
51057

Facit, 5446080 *Farthings*

20 *Shillings*
12

240 *Pence.*
4

960 *Farthings.*

Otherwiſe thus: Firſt, Bring the given Numbers 5673 *l.* into Shillings, and multiply the Shillings by 48, the number of Farthings in a Shilling, and the ſame Effect is thereby likewiſe produced, *viz.*

5673 *Pounds*
20

113490 *Shillings*
48

907680
453840
Facit 5446080 *Farthings.*

12 *Pence*
4

48 *Farthings*

Theſe various Ways of Operation are expreſs'd to inform the Judgment of the Learner, with the Reaſon of the Rule. More Ways may be ſhewn, but theſe are ſufficient even for the meaneſt Capacities.

Queſt. 4. In 458 *l.* 16 *s.* 7 *d.* 3 *qrs.* how many Farthings? To reſolve this Queſtion, conſider the ſeventh Rule of this Chapter, and work as you are there directed, and you will find the aforeſaid given Numbers to amount to 440079 Farthings, *viz.*

l. *s.* *d.* *qrs.*
458—16—7—3
20

9160
Add 16 *ſhillings*

Sum 9176 *ſhillings*
12

18352
9176

110012 *pence*
Add 7

Sum 110019 *pence*
4

440076 *farthings*
3

Sum 440079 *farthings*

This laſt *Queſt.* or any other of this kind, *viz* whe the number given to be reduced conſiſteth of ſever Denominations, may be more conciſely reſolved thu *viz.* When you multiply the *Pounds* by 20 to brin them into *Shillings*, to the Product of the firſt Figure and the Figure ſtanding in the place of Units in th Denomination of *Shillings* ; but becauſe the firſt Figure in the Multiplier is (0) I ſay, 0 times 8 is nothin but 6 is 6, which I put down for the firſt Figure i the Product, then becauſe the Multiplier is 0, I go o no further with it; for if I ſhould the whole Produ would be 0, but proceed, and when I come to multipl by the ſecond Figure in the Multiplier, to the Product of it, I add the Figure ſtanding in the place o Tens in the Denomination of *Shillings*, which is (1) ſaying, 2 times 8 is 16, and (the ſaid Figure) 1 is 17; then I ſet down 7, and carry the Unit to the Product of the next Figures, as is directed in the fifth Rule of the ſixth Chapter foregoing; and finiſh the Work. So that now you may have the whole Product and Sum of Shillings at one Operation, which is the ſame as before, and when you multiply the Shillings by 12 to bring them into Pence (after the ſame manner) add to the Product the Number ſtanding in the Denomination of Pence, and ſo when you multiply the Pence by 4, then bring them into Farthings, add to the Product the Number ſtanding under the Denomination of Farthings. See the laſt *Queſtion* thus wrought.

l. *s.* *d.* *qrs.*
458—16—7—3
20

9176 *Shillings*
12

18359
9176

110019 *Pence*
4

Facit 440079 *Farthings.*

After the Method laſt preſcribed (which if rightly conſidered, differeth not any thing from the 7th Rule of this Chapter) are all the following Examples that are of the ſame Nature wrought and reſolved.

Queſt. 5. In 4375866 *Farthings*, I demand how many *Pounds Shillings*, *Pence* and *Farthings*?

To reſolve this *Queſtion*, Firſt, I divide the given Number of *Farthings* by 4, and the *Quotient* is 1093966 *Pence*; and there remaineth after the Diviſion is ended (which by the 8th Rule foregoing) is two *Farthings*, then I divide 1093966 *Pence* by 12, and the

Quotient is 91163 Shillings, and there remaineth 1o after Diviſion, which by the ſaid 8th Rule is ſo many Pence, *viz.* 10 *d.* then I divide 91163 Shillings by 2o and the Quotient is 4558 *l.* and there remaineth 3 Shillings; ſo the Work is finiſhed, and I find that in 4375806 Farthings, there are 4558 *l.* 3 *s.* 10 *d.* 2 *qrs.* See the Operation.

```
                      12)         2|0)     l.
4) 4375866 (1093966 (9116|3 (4558
   4               108          8
   ---             ---          ---
   37               13          11
   36               12          10
   ---             ---          ---
    15              19          11
    12              12          10
    ---            ---          ---
     38             76          16
     36             72          16
     ---           ---          ---
     26             46          (3) s.
      24            35
      ---          ---
      26           (10) d.
      24
      ---
      (2) qrs.
```

```
          l.          s.        d.        qrs.
Facit, 4558 ———————— 3 ———————— 10 ———————— 2
```

Queſt. 6. In 4386 *l.* I demand how many Groats?

To reſolve this Queſtion, I reduce the given Number of Pounds into Shillings, and they are 87720 Shillings; now I conſider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it produceth 263160 Groats. See the Work.

4386 *Pounds*
20

87720 *Shillings*
3

Facit, 263160 *Groats*

This Queſtion might have been otherwiſe reſolv'd thus, *viz.* conſidering that in a Pound (or 20 Shillings) there are three times 20 Groats which makes 60, by which I multiply the Number of Pounds given, and it produceth the ſame Effect at one Operation, as followeth.

4386 *Pounds*
60 *Groats in* 12 *s*,

Facit, 263160 *Groats* 4386 *l.*

Queſt. 7. In 43758 Three-pences, I deſire to know how many Pounds?

To reſolve this, and many ſuch-like Queſtions; Firſt, I divide my given Number of Three-pences by 4, becauſe 4 Three-pences are in a Shilling, and the Quotient is 10939 Shillings, and there remaineth 2 after Diviſion is ended, which is 2 Three-pences (by the 8th Rule of this Chapter) which are equal in Value to 6 *d.* then I divide 10939 Shillings by 20, and the Quotient giveth 546 *l.* and 19 *s.* remains; ſo that I conclude in 43758 pieces of Three-pence *per* piece, there are 546 *l.* 19 *s.* 6 *d.* as by the Work appeareth.

2|0 *l.* *s.* *d.*
4) 43758 (1093|9 (546—19—06
4 10
37 9
36 8
15 13
12 12
38 19 *ſhillings*
36
(0) *Three-pences*, or 6 *d.*

This Queſtion might have been otherwiſe reſolved thus, *viz.* Firſt multiply the given Number of 3 pence 43758, by three the number of pence in 3 pence, and the Product (*viz.* 13174) is the number of pence equal to the given number of 3 pences, which number of pence may be brought into Pounds by dividing by 12 and by 20, and the Quotient you will find to be equal to the former Work, *viz.* 546 *l.* 19 *s.* 6 *d.*

43758
3
2|0 *l.* *s.* *d.*
12) (131274 (1093|9 (546—19—6
12 10
112 9
108 8
47 13
36 12
114 *rem.* (19) *ſhillings*
108
Rem. (6) *Pence.*

Or thus, Divide the given Number of 3 pences by the Number of 3 pences in a Pound, or 20 Shillings (which you will find to be 80. if you multiply 20 *s.* by 4, the number of 3 pences in a Shilling) and you will find the quote to be 546 *l* as before, and a Remainder of 78 Three-pences, and if you divide thoſe 78 Three-pences by 4 (becauſe there are 4 Three-pences in a Shilling) you will find the quote to be 19*s.* and 2 Three-pences remain, which are equal to 6 *d.* which is the ſame that was before found.

```
8|0) 4375|8 (546—19—6        20
     ...                      4
     ——                      ——
      40                     80
      ——
       37
       32
       ——
       55
       48
     ————
   4) 78 (19s.
      ..
      4
     ———
      38
      36
     ———
     (2) Three-pences or 6 d.
```

Queſt. 8. In 4785 *l.* 13 *s.* how many Pieces of 13½*d.* *per* Piece?

This *Queſtion* cannot be reſolved by Reduction, deſcending or aſcending, abſolutely (becauſe 13½*d.* is no even part of a Pound) but rather by them both jointly, *viz.* by Multiplication and Diviſion; for if you bring the number given into half-pence and divide the half-pence, by the half-pence in 13½*d.* *viz.* 27 the *Quotient*, will be the Anſwer; for having brought 4785 *l.* 13 *s*, into Half-pence, I find it makes 2297112, which I divide by 27, (becauſe there are ſo many Half-pence in $13\frac{1}{2}d$) and the Quote gives 85078 pieces of $13\frac{1}{2}d$. and 6 Half pence remain over and above. Obſerve the Work following,

l. s. s.
4785—13 $13\frac{1}{2}d$.
20 2

95713 *ſhillings* 27 *half-pence.*
24 *half-pence in a ſhilling*

382852
191426

2297112 *half-pence in the given Number*
27) 2297112 (85078 *pieces of* $13\frac{1}{2}d$.
.....

216

137
135

211
189

222
216

Rem. (6) *half-pence.*

It would have produc'd the ſame Anſwer, if you had reduc'd your given Number into Farthings, and divided by the Farthings in $13\frac{1}{2}d$. *viz.* 54; (for always the Dividend and the Diviſor muſt be of one Denomination) and then you would have had a Remainder of 12 Farthings, which are equal in value to the former Remainder of 6 Half-pence, as you may prove at your leiſure.

Queſt. 9. In 540 Dollars at 4 *s.* 4 *d. per* Dollar, how many Pounds *Sterling* ?

Firſt, bring your given number of Dollars into Pence, and then your Pence into Pounds according to the former Directions, thus, in 4 *s.* 4 *d.* (*viz.* a Dollar) you will find 52 Pence, by which multiply 540 Dollars and it produceth 28080 Pence, which if you divide by 240 (the Pence in one Pound) the Quotient will give you 117 *l.* which are equal in value to 540 Dollars, at 4 *s.* 4 *d. per* Dollar.

```
                   s. d.
           540     4—4
            52     12
         ————     ————
          1080     52
         2700
         ————   l.
 24|0) 2808|0 (117
         ...
         24
         ——
         40
         24
         ——
         168
         168
         ———
         (0)
```

The foregoing Queſtion might have been otherwiſe wrought, thus, *viz.* Multiply (540) your given Number of Dollars, by 13 the number of Groats in a Dollar (or 4 *s.* 4 *d.*) and it produceth 7020 Groats, which divide by 60 (the Groats in 1 Pound or 20 Shillings) and the Quote is 117 *l.* as before. See the Work.

```
                          s.  d.
      540                 4—4
       13                 3
     ----               -----
     1620                13
     540
     ----
6|0) 702|0(117
    6
   ----
    10
     6
   ----
    42
    42
   ----
    (0)
```

Queſt. 10 In 547386 Pieces of 4$\frac{1}{2}$*d. per* Piece. I demand how many Pounds, Shillings, and Pence?

Firſt bring your given Number of Four-pence halfpenies all into half-pence, which you will do if you multiply by 9, the number of half-pence in 4$\frac{1}{2}$*d.* and the Products is 4926474 half-pence, which are brought into Pounds, if you divide them by 24 (the half-pence in a Shilling) and 20 (the Shillings in a Pound) it makes 10263 *l.* 9 *s.* 9 *d.*

```
                                              d.
                                              4½
   547386                                     2
        9                                     —
  ———————— 2|0)  l.                           9 half-pence.
24) 4926474 (20526|9 (10263
    ······  ·····
    48       2
    ——      ——
    126      05
    120       4
    ——      ——
     64      12                     l.     s.   d.
     48      12              Facit 10263—9—9
    ——      ——
    167       6
    144       6
    ——      ——
    234 rem. (9) ſhillings.
    216
    ——
Rem. (18) half-pence or 9 d.
```

Queſt, 11. In 4386 *l.* I demand how many Pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each an equal Number? that is to ſay, What number of Six-pences, Groats, and Two-pences will make up 4386 *l.* and the number of each equal?

The way to reſolve Queſtions of this Nature, is to add the ſeveral Pieces (into which the given Number is to be brought) into one Sum, and to reduce the given Number into the ſame Denomination with their Sum, and to divide the ſaid given Number (ſo reduced) by the ſaid Sum, and the quotient will give you the exact number of each piece. And after the ſame Method will we proceed to Reſolve the preſent queſtion, *viz.*

4386

4386 *pounds*
240 *pence*
———
175440
8772
12) 1053640 (87720
. . . . .
95
—
92
84
—
86
84
—
24
24
—
(0)

6 *d.*
4
2
—
Sum 12 *pence*

d. *d.* *d.*
Facit 87720 *pieces of* 6—4—2

So that I conclude by the Operation that 87720 Six-pences, and 87720 Groats, and 87720 Twopences, are juſt as much as (or equal to) 4386 *l.* or if you admit of 5 *s.* to be thus divided, it is equal to 5 Six-pences, and 5 Four-pences or Groats, and 5 Two-pences. *For if two Right Lines or two Numbers be given, and one of them be divided into as many Parts or Segments as you pleaſe, the Rectangle (or Product) comprehended under the two whole Right Lines (or Numbers given) ſhall be equal to all the Rectangles (or Products contain'd under the whole Line (or Number) and the ſeveral Segments (or Parts) into which the other Line (or Number) is divided.* Eucl. 2. 1.

Another Queſtion of the ſame Nature with the laſt, may be this following, *viz.*

Queſt 12. A Merchant is deſirous to change 148 *l.* into Pieces of 31 *d* ½ of 12 *d.* of 9 *d.* of 6 *d.* and of 4 *d.* and he will have of each Sort an equal Number of Pieces, I deſire to know the Number?

Do as you were taught in the laſt Queſtion, *viz.* add the ſeveral Pieces together, and reduce the Sum into

Half-pence, then reduce the Sum to be changed, *viz.* 148 *l.* into the ſame Denomination, and divide the greater by the leſſer, and in the Quotient you will find the Anſwer, *viz.* 798 is the Number of each of the Pieces required, and 18 remaineth, which is 18 Half-pence by the 8th Rule of this Chapter. See the Work as followeth:

l.	*d.*
148	$13\frac{1}{2}$
240 *Pence in a Pound*	12
	9
5920	6
296	4
35520 *Pence in* 148 *l.*	*Sum* 44
2	$2\frac{1}{2}$
71040 *Half-pence*	89 *Half-pence*

89) 71040 (798 *Pieces of each Sort*
623
874
801
730
712
Rem. (18) *Half-pence.*

The Truth of the two foregoing Operations will thus be prov'd, *viz.* Multiply the Anſwer by the Parts, or Pieces into which the given Number was reduced; and having added the ſeveral Products together, if their Sum be equal to the given Number, the Anſwer is right; otherwiſe not.

So the Anſwer to the 11th Queſtion was 87720; which is proved as followeth, *viz.*

87720

		l.
87720	*Six-pences make* —	2193
	Four-pences make —	1462
	Two-pences make —	731

The Total Sum of them 4786 *which was the Sum given to be changed.*

The Anſwer to the 12th Queſtion was 798, and 18 Half-pence remain'd after the Work was ended, now the Truth of the Work may be proved as the former was, *viz.*

		l	*s.*	*d*
798	*Pieces of* 13½ *make*	44	17	09
	Pieces of 12 *make*	39	18	00
	Pieces of 9 *make*	29	18	06
	Pieces of 6 *make*	19	19	00
	Pieces of 4 *make*	13	06	00
and 18 *Half-pence or* 9 *d. remains*		00	00	09
The Total Sum of them		148	00	00

which Total Sum is equal to the Number that was firſt given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy-weight.

We now come to give the Learner ſome Examples in *Troy-weight*, wherein we ſhall be brief, having given ſo large a Taſte of *Reduction* in the following Examples of Coyn, and now the Learner muſt be mindful of the Table of *Troy-weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 7 *oz.* 13 *p. w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures ſtanding in the ſeveral Denominations, according to the Directions given in the 7th Rule of this Chapter, and you will find the Product to be 2780013 Grains, which is the Number requir'd, or Anſwer to the Queſtion. See the whole Work as followeth.

482

```
    l.   oz.  p.w.  gr.
    482—07—13—21
      12
   -------
     971
    482
   -------
    5791 ounces
      20
   --------
   115833 peny-weight
       24
   --------
   463333
  231668
  ---------
fac. 2780013 grains.
```

Queſt. 14. In 2780013 *Grains*, I demand how many Pounds Ounces, Penny-weights, and Grains?

This is but the foregoing Queſtion inverted, and is reſolv'd by dividing by 24, by 20, and by 12, and the *Anſwer* is 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.*

```
                      2|0)         12)        l.
24)   270013      (11583|3      (5791      (482
      ••••••        •••••         •••
      24            10            48
      ---           ---           ---
       38            15            99
       24            14            96
      ---           ---           ---
       140            18            31
       128            18            24
       ---           ---           ---
        200            3 Rem.     (7) Ounces
        192            2
        ---           ---
          81 Rem. (13) penny-weigh.
          72
          93          l.   s.   d.   gr.
          72  facit, 492—07—13—21
Remains  (12) Grains.
```

Queſt. 15. A Merchant ſent to a Goldſmith 16 Ingots of Silver, each containing in weight 2 *l.* 4 *oz.* and order'd it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per* piece, and Salts of 10 *oz.* 10 *p.w. per* Salt, and Spoons of 1 *oz.* 18 *p.w. per* Spoon, and of each an equal number; I deſire to know how many of each Sort he muſt make?

This Queſtion is of the ſame Nature with the 11 and 12th Queſtion foregoing, and may be anſwerd after the ſame Method, *viz.* Firſt, add the Weight of the ſeveral Veſſels (into which the Silver is to be made) into one Sum, and reduce to one Denomination, and they make 1248 Penny-weights; then reduce the Weight of the Ingot into the ſame Denomination, *viz.* Penny-weights, and it makes 560 Penny-weights, and multiply them by the number of Ingots, *viz.* 16, and the Product will give you the Weight of the 16 Ingots, *viz.* 8960, then divide the Product by the Weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz.* 7 and 224 *p.w.* remaining over and above.

l. *oz.*
2 —— 4
12
28
20
560 *penny-weights*
16 *Ingots*
3336
560
1248) 8960 (7 *Veſſels of each*
8736
Rem. (224) *Penny-weights*

l. *oz.* *p w.*
2—08—00
1—06—00
0—10—18
0—01—18
Sum 5—02—08
12
62
20
1248 *p.w.*

The Proof of the Work is as followeth, viz.

		l. oz. p.w.		*l. oz. p.w.*
7	*Bowls of*	2—08—00	*per Bowl is*	18—08—00
	Tank. of	1—06—00	*per Tank. is*	10—06—00
	Salts of	0—10—10	*per Salt is*	06—01—10
	Spoons of	0—1—18	*per Spoon is*	00—01—06
	224 *penny-weight remaining*			00—11—04
			Total Sum	37—04—00

So that you ſee the Sum of the Weight of each Veſſel together with the Remainder is 37 *l.* 4 *oz.* which is equal to the Weight of the 16 Ingots deliver'd. For if 37 *l.* 4 *oz.* be reduced to Penny-weights it makes 8960.

Reduction of Averdupois-weight.

In reducing *Averdupois-Weight*, the Learner muſt have recourſe to the Table of *Averdupois-Weight* deliver'd in the ſecond Chapter foregoing.

Queſt. 16. In 47 C. 1 *qr.* 20 *l.* how many Ounces? Multiply by 4, by 28, and by 16 and the laſt Product will be the Anſwer, 84992 Ounces.

C *qr.* *l.*
47—1—20
4

199 *Quarters*
28

1512
380

5312 *l.*
16

31872
5321

Facit, 84992 *ounces*

Queſt. 17. In 84992 Ounces, I demand how many C. *qrs. l.* and *oz.*

This is the foregoing queſtion inverted, and will be reſolved if you divide by 16, by 28, and by 4, and the *Anſwer* is 47 C. 1 *qr.* 20 *l.* equal to the given Number in the foregoing *Queſtion.*

```
               28)    4)     C.   qr.  l.   oz.
16) 84992  (5312  (189  (47—1—20—00
    ••••     •••
    80       28     16
    ——       ——     ——
    49       251    29
    48       224    28
    ——       ——     ——
    19       172    (1) qr.
    16       252
    ——       ——
    32       (20) pounds.
    32
    —
    (0)
```

Queſt. 18. A Chapman buyeth of a Grocer 4 C. 1 *qr.* 14 *l.* of Pepper, and order'd it to be made up into Parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each parcel an equal number; now I would know the number of each Parcel?

This Example is of the ſame Nature with the 11 and 12, and 15 *Queſtions* foregoing, and after the ſame manner is reſolved. See the Operation as followeth.

4 C.

G.	qrs.	l.		l.
4 —	1 —	14		14
4				12
				8
17				6
28				2
140				42 *l.*
35				

42) 490 (11
42
70 *Facit* 11 *parcels of each*
42

Rem. (28) *pounds*

Reduction of Liquid Meaſures.

Queſt. 19. In 45 Tun of Wine, how many Gallons? Multiply by 4, and by 63, the Product is 11340 Gallons for the Anſwer.

45
4
180
63
540
1080

Facit 11340 *Gallons.*

Queſt. 20. In 34 Rundlets of Wine, each containing 18 Gallons, I demand how many Hogſheads?

Firſt, find how many Gallons is in the 34 Rundlets which you may do if you multiply 34 by 18, the content of a Rundlet, and the Product is 612 Gallons, which you may reduce into Hogſheads, if you divide them by 63, and the Quote will be 9 Hogſheads, and 45 Gallons. See the Work.

34
18

272
34

63) 612 (9 *hdds,*

567

Remains (45) *Gallons*
Facit 9 *hds.* 45 *Gallons*

Queſt 21. In 12 Tuns how many Rundlets of 14 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Rundlet, and the Quotient (216) is your Anſwer. See the Work following.

12
4

48
63

144
288

14) 3024 (216 *run.*

28

22
14

84
84

(0) *Facit* 216 *Rundl.*

Reduction of Long-Meaſure.

Queſt. 22. I demand how many Furlongs, Poles, Inches, and Barly-Corns will reach from *London* to *York* it being accounted 115 Miles ?

151 *miles*
8 *furlongs in a mile*

1208 *furlongs*
40 *poles in a furlong*

48320 *poles*
11 *half yards in a pole*

48320
48320

531520 *half-yards*
18 *inches in half a yard*

4252160
531520

9567360 *inches*
3 *barly-corns in an inch*

Facit 28702080 *barly-corns in* 151 *Miles*

Queſt. 23. The Circumference of the Earth (as all other Circles are) is divided into 360 Degrees, and each Degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 Miles ; now I demand how many Miles, Furlongs, Perches, Yards, Feet and Barly-corns will reach round the Globe of the Earth ?

360	*degrees*
60	*minutes or miles in a degree*
21600	*miles about the Earth*
8	*furlongs in a mile*
172800	*furlongs about the Earth*
40	*perches in a furlong*
6912000	*poles or perches about the Earth*
11	*half yards in a perch*
6912000	
6912000	
2)76032000	*half yards about the Earth*
(38016000	*yards,* viz. *the half-yards*
3	*divided by 2*
114048000	*feet about the Earth*
12	*inches in a foot*
228096000	
114048000	
1368576000	*inches about the Earth*
3	*barley-corns in an inch*
Facit 4105728900	*barley-corns.*

And ſo many will reach round the World, the wh being 21600 Miles; ſo that if any Perſon were to round, and go 15 Miles every Day, he would go t whole Circumference in 1440 Days, which is 3 Yea 11 Months and 15 Days.

Reduction of Time.

Queſt. 24. In 28 Years, 24 Weeks, 4 Days, 16 Hours 30 Minutes, how many Minutes?

```
  years  weeks   days   hours  minutes
   28--—24—---4—---16—---30
   52  weeks in a year
  ————
   60
  142
 —————
 1489 weeks
    7
10364 days
   24
 —————
41462
20729
—————
248752 hours
    60
—————
14925150 minutes.
```

Note, That in reſolving the laſt *Queſtion* after the Method expreſs'd, there is loſt in every Year 30 Hours, For the Year conſiſteth of 365 Days and 6 Hours; but by multiplying the Years by 53 Weeks, which is 364 Days, you loſe 1 Day and 6 Hours every Year; wherefore to find an exact Anſwer, bring the odd Weeks, Days and Hours into Hours, and then multiply the Years by the number of Hours in a Year, *viz.* 8766, and to the Product add the Hours contained in the odd time, and you have the exact time in Hours which bring into Minutes, as before. See the laſt *Queſtion*, thus reſolved.

weeks days hours
24—4—16
7
172
24
694
345
4144 *hours*

days hou.
365—6
24
1466
730
8766 *hours in a Year*

28
8766
172
172
197
228
249592 *hours*
60
14975520 *minutes in* 28 *years and* 4144 *houre.*

So you ſee that according to the Method firſt uſed to reſolve the Queſtion, the Hours contained in the given Time are 248755, but according to the laſt, beſt or true Method, they are 249592, which exceeds the former by 840 Hours.

But for moſt Occaſions it will be ſufficient to multiply the given Years by 365, and to the Product add the Days in the odd time, if there be any, and then there will be only a loſs of ſix hours in every Year, which may be ſupply'd by taking a fourth part of the given Years, and adding it to the contained Days, and you have your Deſire.

Queſt. 25. In 438657540 *Min.* how many Years? *Facit*, 834 Years, 4 Days, 19 Hours.

8766)

```
                      8766      Years Days Hours
6|0) 43865754|0  (7310959  (834—4—19
     42               70128
     --               -----
      18              29815
      18              26298
      --              -----
       6              35179
       6              35064
       --             -----
       57         24) 115 (4 days
       54              96
       --             -----
        35        Rem. (19) Hours
        30
        --
         54
         54
         --
        (0)
```

Queſt. 26. I deſire to know how many Hours and Minutes it is ſince the Birth of our Saviour Jeſus Chriſt to this preſent Year, being accounted 1714 Years?

This Queſtion is of the ſame Nature with the 24th fore-going, and after the ſame Manner is reſolved, *viz.* multiply the given Number of Years by 8766, the Product is 14924924 Hours, and that by 60, and the Product is 920420364 Minutes. See the Work:

```
      1714 Years
      8766 Hours in a Year
  --------
     10284
    10284
   11998
  2612
  --------
  14924924 Hours in 1714 Years
        60
  --------
  920420364 Minutes in 1714 Years.
```

F Note,

Note, That as Multiplication and Diviſion do interchangeably prove each other, ſo Reduction deſcending and aſcending, prove each other by inverting the Queſtion, as the 13th and 14th, and likewiſe the 16th and 17th *Queſtions* foregoing by Inverſion do interchangeably prove each other; the like may be performed for the Proof of any *Queſtion* in Reduction whatſoever.

Thus far have we Diſcourſed concerning Single Arithmetick, whoſe Nature and Parts are defin'd in the ſecond, eight, ninth and tenth Definitions of the third Chapter of this Book; for although Reduction is not reckon'd or defin'd among the parts of Single Arithmetick, yet conſider'd abſtractedly, it is the proper effect of Multiplication and Diviſion, and as for the Extraction of Roots (which ought to be handled in the next Place as parts of Single Arithmetick) we ſhall omit it in this place, and refer the Learner to Mr. *Cocker's Decimal Arithmetick*, which is, (with great Care and Pains) now publiſhed together with his *Logarithmetical Arithmetick*, ſhewing the Geneſis or Fabrick of the Logarithms, and their general Uſe in Arithmetick, *&c.* As alſo his *Algebraical Arithmetick* containing the Doctrine of Compoſing and Reſolving an Equation, with all other Rules neceſſary for the underſtanding of that Myſterious Art, *&c.*

CHAP. IX.

Of Comparative Arithmetick? viz. *The Relation of Numbers one to another.*

1. COmparative Arithmetick, is that which is wrought by Numbers, as they are conſider'd to have Relation one to another, and this conſiſts either in *Quantity*, or in *Quality*.

Boetius's Arith. lib. 1. cap. 21.

2. Relation of Numbers in Quantity, is the reference or reſpect that the Numbers themſelves have one to another, where the Terms or Numbers propounded are always two, the firſt call'd the Antecedent, and the other the Conſequent.

Vid. *Wing Arith.* cap. 34.

3. The Relation of Numbers and Quantity conſiſts in the Differences, or in the Rate or Reaſon that is found betwixt the Terms propounded, the Difference of two Numbers being the Remainder found by Subtraction, but the Rate or Reaſon betwixt two Numbers is the Quotient of the Antecedent divided by the Conſequent, ſo 21 and 7 being given, the Difference betwixt them will be found to be 14, but the Rate or Reaſon that is betwixt 21 and 7, will be found to be triple Reaſon, for 21 divided by 7 quotes 3, the Reaſon or Rate.

Alſted. Mathemat. lib. 2. c. 11, & 12.

4. The Relation of Numbers in Quality (otherwiſe call'd Proportion) is the reference or reſpect that the Reaſon of Numbers have one unto another, therefore the Terms given ought to be more then two. Now this Proportion or Reaſon between Numbers relating one to another, is either Arithmetical, or Geometrical.

Alſted. Mathemat. lib. 2. c. 21.

5. Arithmetical Proportion (by ſome call'd Progreſſion) is, when divers Numbers differ one from another by equal Reaſon, that is, have equal Differences.

So this Rank of Numbers 3, 5, 7, 9, 11, 13, 15, 17, differ by equal Reaſon, *viz.* by 2, as you may prove.

6. In a rank of Numbers that differ by Arithmetical Proportion, the Sum of the firſt and laſt Term being multiply'd by half the number of Terms, the Product is the total Sum of all the Terms.

Or, if you multiply the number of the Terms by the half-ſum of the firſt and laſt Terms, the Product is the total Sum of all the Terms.

So in the former Progreſſion given, 3 and 17 is 20, which multiply'd by 4, *viz.* half the number of Terms the Product gives 80, the Sum of all the Terms; or multiply 8 (the Number of Terms) by 10 (half the Sum of the firſt and the laſt Term) the Product gives 80, as before.

So alſo 21, 18, 15, 12, 9, 6, 3, being given, the Sum of all the Terms will be found to be 84; for there the Number of Terms is 7, and the Sum of the firſt and laſt (*viz.* 21 and 3) is 24, half whereof (*viz.* 12) multiply'd by 7, produceth 84, the Sum of the Terms ſought.

7. Three Numbers that differ by Arithmetical Proportion, the Double of the Mean (or Middle Number) is equal to the Sum of the Extreams.

So 9, 12, and 15, being given the double of the Mean 12 (*viz.* 24) is equal to the Sum of the two Extreams 9 and 15.

8. Four Numbers that differ by Arithmetical Proportion (either continu'd or interrupted) the Sum of the two Means is equal to the Sum of the two Extreams.

So 9, 12, 18, 21, being given, the Sum of 12 and 18, will be equal to the Sum of 9 and 21, *viz.* 30; alſo 6, 8, 14, 16, being given, the Sum of 8 and 14, is equal to the Sum of 6 and 16, *viz.* 22, &c.

Vide *Wing. Arith.* cap. 35.

9. Geometrical Proportion (by ſome call'd Geometrical Progreſſion) is, when divers Numbers differ according to right Reaſon.

So 1, 2, 4, 8, 16, 32, 64, &c. differ by Double Reaſon. And 3, 9, 27, 81, 243, 729, differ by Triple Reaſon; 4, 16, 64, 456, &c. differ by Quadruple Reaſon, &c.

10. In any Numbers that increaſe by Geometrical Proportion, if you multiply the laſt Term by the Quotient of any one of the Terms divided by another of the Terms, which being leſs is next unto it, and having deducted, or ſubſtracted the firſt Term out of that Product, divide the Remainder by a Number that is an Unit leſs than the ſaid Quotient, the laſt quote will give the Sum of all the Terms.

So 1, 2, 4, 8, 16, 32, 64, beeing given, firſt I take one of the Terms, *viz.* 8, and divide it by the Term which is leſs and next to it, (*viz* by 4) and the Quotient is 2, by which I multiply the laſt Term 64, and the Product is 128 from whence I ſubſtract the firſt Term, (*viz.* 1) the Remainder is 127, which divided by the Quotient 2 made leſs by 1 (*viz.* 1) the Quote is 127, for the Sum of all the given Terms, as by the Work in the Margent.

64
4) 8 (2
128
1
1) 127 (127

So if 4, 16, 64. 256, 1024, were given, the Sum of all the Terms will be found to be 1363. For firſt, I divide 64, one of the Terms, by his next leſſer Term, and the Quotient is 4, by which I multiply the laſt Term 1024, and it produceth 4096; from whence I ſubſtract the firſt Term 4, and the Remainder is 4092, which I divide by the Quote leſs by 1, (*viz.* 3) and the Quote is 1364, for the Total Sum of all the Terms, as *per* Margent.

1024
16)64(4
4096
4
3)4092(1364.

So likewiſe if 2, 6, 18, 54, 162, 486 were given, the Sum or Total of all the Terms will be found to be 738. See the Work.

486
6) 81 (3
1458
2
2) 1456(728

11. Three Geometricall Proportionals given, the ſquare of the Mean is equal to the Rectangle or Product of the Extreams.

So 8, 16, 32, being given, the Square of the Mean, *viz.* 16 is 256, which is equal to the Product of the Extreams 8 and 32, for 8 times 32 is equal to 256.

12. Of four Geometrical Proportional Numbers given, the Product of the two Means is equal to the Product of the two Extreams.

So 8, 16, 32, 64, being given, I ſay, that the Product of the two Means, *viz.* 16 times 32, which is 513, is equal to 8 times 64 the Product of the Extreams.

Alſo if 3, 9, 21, 69, were given (which are interrupted) I ſay, 9 times 21 is equal to 3 times 63, which is equal to 189.

From hence ariſeth that precious Gem in Arithmetick, which for the Excellency thereof is call'd the *Golden Rule, or Rule of Three.*

CHAP. X.

The Single Rule of Three Direct.

THE *Rule of Three* (not undeſervedly call'd the *Golden Rule*) is that by which we find out a fourth Number in proportion unto three given Numbers, (ſo as this fourth Number ſought may bear the ſame Rate, Reaſon or Proportion to the third (given) Number, as the ſecond doth to the firſt, from whence it is call'd the *Rule of Proportion.*

2. Four Numbers are ſaid to be Proportional, when the firſt containeth, or is contain'd by the ſecond, as often as the third containeth or is contain'd by the fourth. Vide *Wingates's Arith.* Chap. 8. Sect. 4.

So theſe Numbers are ſaid to be Proportionals, *viz.* 3, 6, 9, 18, for as often as the firſt Number is contained in the ſecond, ſo often is the third contain'd in the fourth, *viz.* twice. Alſo 3, 9, 5, 15, are ſaid to be Proportionals; for as often as the firſt Number containeth the ſecond, ſo often the third Number containeth the fourth, *viz.* 3 times.

3. The *Rule of Three*, is either Simple or Compound.

4. The Simple (or Single) *Rule of Three* conſiſteth of 4 Numbers; that is to ſay, it hath 3 Numbers given to find out a fourth, and this is either Direct or Inverſe. Vide *Alſted. Math.* lib. 2. 13.

5. The *Single Rule of Three Direct* is, when the Proportion of the firſt Term is to the ſecond, as the third is to the fourth, or when it is requir'd that the Number

ſought (*viz.*) the fourth Number muſt have the ſame proportion to the ſecond, as the third hath to the firſt.

6. In the *Rule of Three*, the greateſt Difficulty is (after the Queſtion is propounded to diſcover the order of the 3 Terms, *viz.* which is the firſt, which is the ſecond, and which the third, which that you may underſtand, obſerve, That (of the three given Numbers) two always are of one Kind, and the other is of the ſame Kind with the Proportional Number that is ſought; as in this Queſtion, *viz.* if 4 Yards of Cloth coſt 12 Shillings, what will 6 Yards coſt at that rate? Here the two Numbers of one kind are 4 and 6, *viz.* they both ſignif ſo many Yards, and 12 Shillings is the ſame Kind with the Number ſought, for the price of 6 Yards is ſought.

Again obſerve, that of the three given Numbers thoſe two that are of the ſame kind, one of them muſt be the firſt, and the other the thrid, and that which is of the ſame kind with the Number ſought, muſt be the ſecond Number in the *Rule of Three*, and that you may know which of the ſaid Numbers to make your firſt, and which your third, know this, that to one of theſe two Numbers there is always affixed a Demand, and that Number upon which the Demand lieth muſt always be reckon'd the third Number. As in the foremetioned Queſtion, the Demand is affixed to the Number 6, for it is demanded, what 6 Yards will coſt, and therefore 6 muſt be the third Number) and 4 (which is of the ſame denomination or kind with it) muſt be the firſt, and conſequently the Number 12 muſt be the ſecond, and then the Numbers being placed in the forementi-on'd Order will ſtand as followeth, *viz.*

yards	*s.*	*yards*
4	12	6

7. In the *Rule of Three Direct* (having placed the Number as is before directed, the next thing to be done will be to find out the fourth Number in Proportion, which that you may do, multiply the ſecond Number

by the third, and divide the Product thereof by the firſt, or (which is all one) multiply the third Term (or number) by the ſecond, and divide the Product thereof by the firſt, and the Quotient thence ariſing is the 4th Number in a direct Proportion, and is the Number ſought, or Anſwer to the Queſtion, and is of the ſame Denomination that the ſecond number is of. As thus, let the ſame Queſtion be again repeated, *viz.* If 4 Yards of Cloth coſt 12 Shillings, what will 6 Yards coſt?

Having placed my Numbers according to the ſixth Rule (of this Chapter) foregoing, I multiply (the ſecond Number) 12 by (the third Number) 6, and the Product is 72, which Product I divide by (the firſt number) 4, and the Quotient thence ariſing is 18, which is the fourth Proportional or Number ſought, *viz.* 18 Shillings, (becauſe the ſecond Number is Shillings) which is the Price of 6 Yards, as was required by the Queſtion. See the Work following.

```
      yds.    s.    yds.    s.
   If 4 —— 12 —— 6 —— 18
             6
          ————
      4) 72 (18 ſhillings
          ..
          4
         ————
          32
          32
         ————
          (0)
```

Queſt. 2. Another Queſtion may be this, *viz.* If 7 C. of Pepper coſt 21 *l.* how many will 16 C. coſt at that rate?

To reſolve which Queſtion, I conſider that (according to the ſixth Rule of this Chapter) the Terms or numbers ought to be placed thus, *viz.* the Demand lying upon 6 C. it muſt be the third Number and that of the ſame kind with it muſt be the firſt, *viz.* 7 C. and 21 *l.* (being of the ſame kind with the number ſought) muſt be the ſecond number in this *Queſtion*; then I proceed according to this 7th Rule, and multiply the ſecond number by the third, *viz.* 21 by 16, and the Product is 336, which I divide by the firſt number 7, and the quotient is 48 *l.* which is the value of 16 C. of Pepper at the rate of 21 *l.* for 7 C. See the Work following.

C. *l.* C.
7——21——16
16

126
21
——— *l.*
7) 336 (48.

28
———
56
56 *Fac.* 48 *l.*
———
(0)

8. If when you have divided the Product of the ſecond and third Numbers by the firſt, any thing remain after Diviſion is ended, ſuch Remainder may be multiply'd by the parts of the next inferior Denomination, that are equal to an Unit (or Integer) of the ſecond number in the *Queſtion,* and the Product thereof divide by the firſt number in the *Queſtion,* and the *Quotient* is of the ſame Denomination with the parts by which you multiply'd the Remainder, and is part of the fourth Number which is ſought. And furthermore, if any thing remain, after this laſt Diviſion is ended, multiply it by the parts of the next inferior Denomination equal to an Unit of the laſt *Quotient,* and divide the Product by the ſame Diviſor, (*viz.* the firſt number in the *Queſtion*) and the *Quote* is ſtill of the ſame Denomination with your Multiplier; follow this Method until you have reduced your Remainder into the loweſt Denomination, *&c.* An Example or two

will make this Rule very plain, which may be this following.

Queſt 3. If 13 Yards of Velvet (or any other Thing) coſt 21 *l.* what will 27 Yards of the ſame coſt at that rate?

Having ordered and wrought my Numbers according to the 6th and 7th Rules of this Chapter, I find the Quotient to be 43 *l.* and there is a Remainder of 8, ſo that I conclude the price of 27 Yards to be more than 43 *l.* and to the Intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſaid Remainder 8 by 20 *s.* (becauſe the ſecond Number in the Queſtion was Pounds) and the Product is 160, which divided by the firſt Number, *viz.* it quotes 12, which are 12 Shillings, and there is yet a Remainder of 4, which I multiply by 12 Pence, (becauſe the laſt Quotient was Shillings) and the Product is 48, which I divide by 13 (the firſt Number) and the Quotient is 3 *d.* and yet there remaineth 9, which I multiply by 4 Farthings, and the Product is 36, which divided by 13 again it quotes 2 Farthings, and there is yet a Remainder of 10, which (becauſe it cometh not to the Value of a Farthing) may be neglected; or rather ſet after the 2 Farthings over the Diviſor, with a Line between them; and then (by the 21ſt and 22d Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a Farthing; ſo that I conclude, that if 13 Yards of Velvet coſt 21 *l.* 27 Yards of the ſame will coſt 43 *l.* 12 *s.* 3 *d.* 2 $\frac{10}{13}$ *qrs.* which Fraction is 10 thirteens of a Farthing. See the Operation as followeth.

yds. *l.* *yds.*

If 13——21——27

27

149

42

13) 567 (43 *l.*

52

47

39

Remain. (8)

Multiply 20

13) 160 (12

13

30

26

Remains (4)

Multiply 12

13) 48 (3 *d.*

39

Remains (9)

Multiply 4

qrs.

13) 36 (2$\frac{10}{13}$

26

l. *s.* *d.* *qrs.*

Remains 10 *facit* 43—12—3—2$\frac{10}{13}$

Queſt. 4. Another Example may be this following, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that rate?

Work according to the laſt Rule, and you will find it to amount to 921 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* and by the 5th Rule of the 8th Chapter 921 *s.* may be reduc'd to 46 *l.* 1 *s.* So that then the whole worth or value of the 478 *l.* will be 46 *l.* 1 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* the whole Work followeth.

l. s. d.
If 14—27—478
27
3346
956
2|0
14) 12906(92|1(46 *l.*
126 8
30 12
28 12
26 (1) *s.*
14
Remains (12)
Multiply 12
24
12
14) 144 (10 *d.*)
14
Remains (4)
Multiply 4
14 (16) 1 $\frac{2}{14}$ *gr.*
14
Remains (2)
l. s. d. qrs.
Facit, 46—1—10—1 $\frac{2}{14}$

9. In the *Rule of Three* it many Times happeneth, that although the firſt and third Numbers be Homogeneal (that is, of one kind) as both Money, Weight, Meaſure, *&c.* yet they may not be of one Denomination, or perhaps they may both conſiſt of many Denominations; in which Caſe you are to reduce both Numbers to one Denomination; and likewiſe your ſecond Number (if it conſiſteth at any time of diverſe denominations) muſt be reduced to the leaſt Name mention'd, or lower if you pleaſe, which being done, multiply the ſecond and third together, and divide by the firſt, as is directed in the 7th Rule of this Chapter.

And note, that always the Anſwer to the *Queſtion* is in the ſame Denomination that your ſecond Number is of, or is reduced to, as was hinted before.

Queſt. 5. If 15 Ounces of Silver be worth 3 *l.* 15 *s.* what are 86 Ounces worth at that rate?

In this *Queſtion*, the numbers being order'd according to the 6th Rule of this Chapter, the firſt and third numbers are Ounces, and the ſecond Number is of diverſe Denominations, *viz.* 3 *l.* 15 *s.* which muſt be reduced to Shillings, and the Shillings multiply'd by the third Number, and the Product divided by the firſt, gives you the Anſwer in Shillings, *viz.* 430 Shillings which are reduced to 21 *l.* 10 *s.*

oz. *l.* *s.* *oz.*
If 15——3——15——86
20
————
75
86
————
458
600
———— (2|6 *l.* *s.*
15) 6450 (43|0 (21—10
. . .
60 4
—— ——
45 3
(0) (10) *Shillings*

In reſolving the laſt Queſtion, the Work would have been the ſame, if you had reduced your ſecond Numbers into Pence, for then the Anſwer would have been 5160 Pence equal to 21 *l.* 10 *s.* or if you had reduced the ſecond Number into Farthings, the Quotient or Anſwer would have been 20640 Farthings, equal to the ſame, as you may prove at your leiſure.

Queſt. 6. If 8 *l.* of Pepper coſt 4 *s.* 8 *d.* what will 7 C. 3 *qrs.* 14 *l.* coſt? In this Queſtion the firſt Number is 8 *l.* and the third is 7 C. 3 *qrs.* 14 *l.* which muſt be reduced to the ſame Denomination with the firſt, *viz.* into Pounds, and the ſecond Number muſt be reduced into Pence, then multiply and divide according to the 7th Rule foregoing, and you will find the Anſwer to be 6174 Pence, which is reduced into 25 *l.* 14 *s.* 6 *d.*

```
    l.   s. d.          C. qrs. l.
 If 8 coſt 4—8 what will 7—3—14 coſt ?
          12                4
        ------           -------
          56               31
                           28
                         -------
                           152
                           63
                         -------
                           882
                            56 ſecond Number
                         -------
                          5292
                         4410
                         -------    12)     2|0)  l.  s.  d.
                     8) 49392   (6174   (51|4(25—14—6
                        ••••     •••     ••
                        48       60      4
                        ----     ----    ----
                         13       17     11
                          8       12     10
                        ----     ----    ----
                         59       54    (14) s.
                         56       48
                        ----     ----
                          32     (6) d.
                          32
                        ----          l.  s.  d.
                         (0) Facit 25—14—6
```

Queſt. 7. If 3 C. 1 *qr.* 14 *l.* of Raiſons coſt 9 *l.* 9 *s.* what will 6 C 3 *qrs.* 20 *l.* of the ſame coſt ?

Here the firſt and third Numbers each conſiſt of divers Denominations, but muſt be brought both into one Denomination, *&c* as you ſee in the Operation which followeth, the Anſwer is, 388 *s.* which is reduc'd into 19 *l.* 8 *s.*

```
     C. qr. l.          l.  s.            C. qr. l.
If   3—1—14    coſt    9—9   what will   6—3—20   coſt?
     4                 20                4
   ———               ————              ———
     13                189               27
     28                                  28
   ———                                 ———
     108                                 216
     27                                  56
   ———                                 ———
     378 Pounds                          776 Pounds
                                         189 ſecond Number.
                                       ————
                                         6984
                                        6208
                                       776
                              ————————2|0)  l.   s.
                              378)146664(38|8(19—8
                                             2
                                  1134     ———
                                  ————      18
                                  3326      18
                                  3024     ———
                                  ————     (8) s.
                       l.  s.     3024
                 Facit 19--8      3024
                                  (0)
```

Queſt. 8. If in 4 Weeks I ſpend 13 *s.* 4 *d.* how long will 53 *l.* 6 *s.* laſt me at that rate ?

Anſwer, 2238 Days, equal to 6 Years, 48 Days. See the Work.

s. *d.* *w.* *l.* *s.*
If 13--4 *require* 4 *what will* 53---6 *coſt?*
12 7 20

30 28 *days* 1066
13 12

160 2132
1066

12792 *Pence*
28 *ſec. num.*

102336
25584
395)
16|0) 35817|6 (2238 (6 *ye.*
2190
32
Rem. (48) *days*
38
32

61 *ye. days*
48 *Facit* 6—48 $\frac{96}{160}$

137
128

Remains (96)

Queſt. 9. Suppoſe the Yearly Rent of a Houſe, a Yearly Penſion, or Wages be 73 *l*, I deſire to know how much it is *per* Day?

Here you are to bring the Year into Days, and ſay, if 365 Days require 73 *l.* what will 1 Day require?

Now when you come to multiply 73 by 1, the Product is the ſame; for 1 neither multiplyeth nor divideth, and 73 cannot be divided by 365, becauſe the

Diviſor is bigger than the Dividend; wherefore bring the 73 *l.* into Shillings, and they make 1460, which divide by the firſt Number 363, and the Quote is 4 Shillings for the Anſwer; as you ſee in the Work.

Days *l.* *Day*
If 365 —— 73 —— 1
20
————
365) 1460 (4 *s*
1460
————
(0)

Facit 3 *s. per Day*

Queſt. 10. A Merchant bought 14 Pieces of Broadcloth, each Piece containing 28 Yards, for which he gave after the rate of 13 *s.* 6 $\frac{1}{2}$ *d. per* Yard; now I deſire to know how much he gave for the 14 Pieces at that rate?

Firſt find out how many Yards are in the 14 Pieces, which you will do if you multiply the 14 Pieces by 28 (the number of Yards in a Piece) and it makes 392 then ſay, if 1 Yard coſt 13 *s.* 6 *d.* $\frac{1}{2}$ *d.* what will 392 Yards coſt? Work as followeth, and the Anſwer you will find to be 127400 Half-pence, which reduced make 265 *l.* 8 *s.* 4 *d.* For after you have multiply'd your ſecond and third numbers together, the product is 127400, which (according to the Seventh Rule) ſhould be divided by the firſt nnmber, but the firſt number is 1, which neither multiplieth nor divideth, and therefore the Quotient or fourth number is the ſame with the product of the ſecond and third; which is in Half-pence, becauſe the ſecond Number was ſo reduced; See the Work as followeth.

28
14

112
28

392 *yards in the* 14 *pieces.*

yds. *s.* *d.* *yds.*
If 1 *coſt* 13—6½ *what will* 392 *coſt?*
12 325 *the ſecond number*

32 1960
13 784
1176
162 2|0) *l.*
2 24) 127400 (530|8 (265

half pen. 325 120 4

74 13
72 12

200 10
192 10

(8) *ſhillings*
l. *s.* *d.* *Rem.* (8) ½ *pence*, or 4 *d.*
Facit 65—8—4

Queſt. 11. A Draper bought 420 Yards of Broad-Cloth, and gave for it after the rate of 14 *s.* 10 *d. per* Ell *Engliſh*, now I demand how much he paid for the whole after that rate?

Bring your Ells into Quarters, and your given Yards into Quarters, the Ell is 5 Quarters, and in 420 Yards are 1680 Quarters; then ſay, If 5 Quarters coſt 14 *s.* 10¾ *d.* (or 715 Farthings) what will 1680 Quarters coſt? *Facit*, 256 *l.* 5 *s.* 0 *d.* See the Operation.

```
   Ell                 Quarters
    1                    420
    5                      4
   ---                ----------
    5                   1680 qrs.

qrs.   s.        d.
If 5 — 14 ——— 10¾ ———    1680
       12                 715
      ----              --------
       28                8400
      15                1680
      ----             11760
     178 d.          ———————— 96|0)
        4          5) 1201200 (24024|0 (250 l.
      ----            ......
     715 qrs.           10          192
                       ----        -----
                        20          482
                        20          480
                       ----        -----
                         12 rem. (240) qrs. or 5 s.
                         10
                        ----
                         20
                         20
       l.  s.  d.       ----
Facit 250—5—0           (0)
```

Queſt. 12. A Draper bought of a Merchant 50 Pieces of Kerſeys, each Piece containing 34 Ells *Flemiſh* (the Ell *Flemiſh* being 3 quarters of a Yard) to pay after the rate of 8*s.* 4 *d. per* Ell *Engliſh*, I demand how much the 50 Pieces coſt him at that rate?

Firſt, find out how many Ells *Flemiſh* are in the 50 Pieces by multiplying 50 by 34, the Product is 1700, which bring into Quarters by 3, it makes 5100 Quarters, then proceed as in the laſt Queſtion, and the Anſwer you will find to be 102000 Pence, or 425 *l.* See the Operation as followeth:

If

```
qrs.  s.  d.                 qrs.
If 5——8——4———————————5100              50
   12                    100              34
  ———                 ————————  d.      ———
  100 d.  5)        510000 (10200        200
                     ....                 150
                  5                     ————————
                 ———                     1700 Ells Flem.
                  10                        3
                  10                     ————————
                ——————                   5100
                 (0)          2|0)         l.
           12) 102000 (850|0  (425
                   ..     ..
                  96      8
                ——————   ———
                  60      5
                  60      4
              ——————————  ——————
                  (0)     10
                          10
                          ———
      Facit. 425 l.       (0)
```

Queſt. 13. A Goldſmith bought a Wedge of Gold which weighed 14 *l.* 3 *oz.* 8 *p. w.* for the Sum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? *Anſwer*, 60 Shillings or 3 *l.* See the Work.

```
 l.        oz.        p.w.        l.          s.        oz.
If 14————————3————————8————————514——————————4——————————1
 12                               20 Shillings            20
———                            ——————————               ————
 31                               10284                   20 p. w.
 14                               20 p w.
———                    ————————————2|0)
171 oz.          5428) 205680 (6|0 (3 l.
 20                      ..  6
———                   205680 ———————————        s.   l.
3428 p. w.          ————————  (0)    Facit 60 or 3
                       (0)
```

Queſt. 14 A Grocer bought 4 *hhds.* of Sugar, each weighing near 6 C. 2 *qrs.* 14 *l*, which coſt him 2 *l* 8 *s.* 6 *d. per* C. I demand the Value of the 4 *hhds.* at that rate?

Firſt, find the weight of the 4 *hhds.* which you may do by reducing the Weight of one of them into Pounds and multiply them by 4 (the number of *hhds*) and they make 2968 *l.* then ſay, If 1 C. or 112 *l.* coſt 2 *l.* 8 *s.* 6 *d.* what will 2968 *l.* coſt? *Facit*, 64 *l.* 5 *s.* 3 *d.* As by the Operation;

```
                                                  C.  qrs.  l.
                                                  6 ——2——— 14
                                                  4
                                                 ———
                                                  26
                                                  28
                                                 ———
     l.   l.  s.  d.     l.                       212
 If 112—2—8—06—2968                               53
          20            582                     ———
         ———          ———                         742 l. in 1 hhd.
          48            5936                        4 hogſhead.
          12           23744                    ———
         ———           14840                     2968 l. in 4 hhd.
         102                                     12)    2|0)
          48  112)   1727376                  (15423  (128|5  (64 l.
         ———          ......                    ....     ..
         582          112                        12      12
                      ———                        ——      ——
                      607                        34       8
                      560                        24       8
                      ———                        ——      ——
                      473                        102    (5) ſhillings
                      448                        96
                      ———                        ——
                      257                        63
                      224                        60
                      ———                        ——
                      336                       (3) pence
                      336
                      ———             l.  s.  d.
                    Facit,            64—5—3
```

Queſt. 15. H Draper bought of a Merchant 8 Packs of Cloth, each Pack containing 4 Parcels, and each Parcel 10 Pieces, and each Piece 26 Yards, and gave after the rate of 4 *l.* 16 *s.* for 6 Yards, now I deſire to know how much he gave for the whole? *Anſwer*, 6656 *l.*

Firſt find out how many Yards there were in the 8 Packs. and by the following Work you will find there are 8320 Yards; then ſay, If 6 Yards coſt 4 *l.* 16 *s.* what will 8320 Yards coſt, *&c.*

8 *Packs*
4
32 *Parcels*
10
320 *Pieces*
26
1920
640
8320 *yds.*

yds. *l.* *s.* *yds.*
6—4—16—8320
20 96
96 49920
74880
2|0)
6) 798720 (13911|0 (6656 *l.*
6 12
19 13
18 12
18 11
18 10
07 12
6 12
12 (0)
12

Facit 6656 *l.*
(0)

By this time the Learner is (as I ſuppoſe) well-exerciſed in the Practick and Theorick of the *Rule of Three Direct*; but at his leiſure he may look over the following Queſtions, whoſe Anſwers are given, but the Operation purpoſely omitted as a Touchſtone for the Learner, thereby to try his Ability in what hath been delivered in the former Rules.

Queſt. 16. If 24 *l.* of Raiſins coſt 6 *s.* 6 *d.* what will 18 Frails coſt, each weighing Neat 3 *qrs.* 18 *l.* *Anſwer*; 24 *l.* 17 *s.* 3*d.*

Queſt. 17. If an Ounce of Silver be worth 5 Shillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10 *p.w.*? *Anſwer*, 313 *l.* 5 *s.*

Queſt. 18. If a Piece of Cloth coſt 10 *l.* 16 *s.* 8 *d.* I demand how many Ells *Engliſh* there are in the ſame, when the Ell at that rate is worth 8 *s.* 4 *d.*? *Anſwer*, 26 Ells *Engliſh.*

Queſt. 19. A Factor bought 24 Pieces of Stuffs, which coſt him in all 537 *l.* 12 *s.* at 5 *s.* 4 *d.* *per* Yard, I demand how many Yards there were in all, and how many Ell *Engliſh* were contain'd in a Piece of the ſame? *Anſwer*, 2016 Yards in all, and 19 $\frac{1}{5}$ Ells *Engliſh per* Piece.

Queſt. 20. A Drapper bought 242 Yards of Broadcloth, which coſt him in all 254 *l.* 10 *s.* for 86 Yards of which he gave after the rate of 21 *s.* 4 *d.* *per* Yards I demand how much he gave *per* Yard for the remainder? *Anſwer*, 20 *s.* 10 *d.* $\frac{64}{155}$ *per* Yard.

Queſt. 21. A Factor bought a certain Quantity of Serge and Shalloon, which together coſt him 226 *l.* 14 *s.* 10 *d.* the Quantity of Serge he bought was 48 Yards at 3 *s.* 4 *d.* *per* Yard; and for every 2 Yards of Serge he had 5 Yards of Shalloon; I demand how many Yards of Shalloon he had, and how much the Shalloon coſt him *per* Yard? *Anſwer*, 120 Yards of Shalloon at 1 *l.* 16 *s.* 5$\frac{53}{122}$ *per* Yard.

Queſt. 22. An Oyl-man bought 3 Tuns of Oyl, which coſt him 151 *l.* 14 *s.* and ſo it chanced that it leak'd out 82 Gallons; but he is minded to ſell it again, ſo that he may be no Loſer by it; I demand how he muſt ſell it *per* Gallon? *Anſwer*, At 4 *s.* $6\frac{174}{871}$ *d. per* Gallon.

Queſt. 23. Bought 6 Packs of Cloth, each Pack containing 12 Cloths, which at 8 *s.* 4 *d. per* Ell *Flemiſh*, coſt 1080 *l.* I demand how many Yards there were in each Cloth? *Anſwer*, 27 Yards in each Cloth.

Queſt. 24. A Gentleman hath 536 *l. per Annum*, and his Expences are one Day with another 18 *s.* 10 *d.* 3 *qrs.* I deſire to know how much he layeth up at the Year's end? *Anſwer*, 191 *l.* 3 *s.* 6 *d.* 1 *qr.*

Queſt. 25. A Gentleman expendeth daily one Day with another 27 *s.* $10\frac{1}{2}$ *d.* and at the Year's end layeth up 340 *l.* I demand how much is his Yearly Income? *Anſwer*, 848 *l.* 14 *s.* $4\frac{1}{2}$ *d.*

Queſt. 26. If I ſell 14 Yards for 10 *l.* 10 *s.* 0 *d.* how many Ells *Flemiſh* ſhall I ſell for 283 *l.* 17 *s.* 6 *d.* at that Rate? *Anſwer*, $504\frac{2}{3}$ Ells *Flemiſh*.

Queſt. 27. If 100 *l.* in 12 Months gain 6 *l.* Intereſt, how much will 75 *l.* gain in the ſame Time, and at the ſame Rate? *Anſwer*, 4 *l.* 10 *s.*

Queſt. 28. If 100 *l.* in 12 Months gain 6 *l.* Intereſt, how much will it gain in 7 Months at that Rate? *Anſwer*, 3 *l.* 10 *s.*

Queſt. 29. A certain Uſurer put out 75 *l.* for 12 Months, and receiv'd Principal and Intereſt 81 *l.* I demand what Rate *per Cent.* he receiv'd Intereſt? *Anſwer*, 8 *l. per Cent.*

Queſt. 30. A Grocer bought 2 Cheſts of Sugar, the one weighed Neat 17 C. 3 *qrs.* 14 *l.* at 2 *l.* 6 *s.* 8 *d. per* C. the other weighed Neat 18 C. 1 *qr.* 21 *l.* at $4\frac{1}{2}$ *d. per l.* which he mingled together, now I deſire to know how much a C. weight of this Mixture is worth? *Anſwer*, 2 *l.* 4 *s.* $2\frac{5569}{4067}$ *qrs.*

Queſt. 31. Two Men, *viz.* A and B, departed both from one Place, the one goes *Eaſt*, and the other *Weſt*, the one travelleth 4 Miles a Day, and the other 5 Miles a Day, how far are they diſtant the 9th Day after their Departure? *Anſwer*, 91.

Queſt. 32, A flying every Day 40 Miles, is purſu'd the 4th Day after by B, poſting 50 Miles a Day, now the Queſtion is, In how many Days, and after how many Miles Travel will A be overtaken ?

More's Arith. cap. 8. qu. 7.

Anſwer, B overtakes him in 32 Days, when they have travell'd 600 Miles.

11. The general Effect of the *Rule of Three Direct*, is contain'd in the Definition of the ſame, that is, to find a fourth Number in Proportion conſiſting of two equal Reaſons, as hath been fully ſhewn in all the fore-going Examples.

The ſecond Effect is, by the Price or Value of one Thing, to find the Price or Value of many Things of like kind.

The third Effect is, by the Price or Value of many Things, to find the Price of one, or by the price of many Things, (the ſaid price being one) to find the price of many Things of like kind.

The 4th Effect is, by the price or value of many things to find the price or value of many Things of like kind.

The 5th Effect is, thereby to reduce any Number of Monies, Weights, or Meaſure, the one Sort into the other, as in the Rules of Reduction, contain'd in the 8th Chapter fore-going. Examples of its various Effects have been already anſwer'd.

12. The *Rule of Three Direct* is thus prov'd, *viz.*

Multiply the 1ſt Number by the 4th and note the product, then multiply the 2d Number by the 3d, and if this product is equal to the product of the 1ſt or 4th, then the Work is rightly perform'd otherwiſe it is erroneous.

The Proof of the Rule of 3 Direct.

So the firſt Queſtion of this Chapter (whoſe Anſwer or 4th Number we found to be 18 *s*) is thus prov'd, *viz.* the 1ſt Number is 4, which multiply'd by 18 (the 4th,) produceth 72, and the 2d and 3d Numbers are 12 and 6, which multiply'd together produce 72, equal to the product of the 1ſt and 4th and therefore I conclude the Work to be rightly perform'd.

Always obſerving, that if any Thing remain after you have divided the Product of the ſecond and third Numbers by the firſt, ſuch Remainder in proving the ſame, muſt be added to the Product of the firſt and fourth Numbers, whoſe Sum will be equal to the Product of the ſecond and third (the ſecond Number being of the ſame Denomination with the fourth, and the firſt of the ſame Denomination with the third)

So the fourth Queſtion of this Chapter being again repeated, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that Rate? The Anſwer (or fourth Number) was 46 *l.* 1 *s.* 10 *d.* 1 *qr.* $\frac{2}{14}$, which is thus prov'd; *viz.* bring the fourth Number into Farthings, and it makes 44249, which multiply'd by the firſt Number 14, produceth 619488, (the ſecond which remaineth being added thereto;) then (becauſe I reduce my fourth Number into Farthings) I reduce my ſecond (*viz.* 27 *s.*) into Farthings, and they are 1296, which multiply'd by the third Number 478, their Product is 619488, equal to the Product of the firſt and fourth Numbers, Wherefore I conclude the Operation to be true. This is an infallible way to prove the *Rule of Three Direct*; and it is deduced from the 12th Section of the 9th Chapter of this Book.

Thus much concerning the *Single Rule of Three Direct*, and I queſtion not but that by this time the Learner is ſufficiently qualify'd to reſolve any Queſtion pertinent to this Rule, not relying upon Fractions or Geometrical Magnitudes. Thoſe that are deſirous to ſee the Demonſtration of this Rule, let them read the ſixth Chapter of (the ingenious) Mr. *Kerſey*'s Appendix to Mr. *Wingate*'s Arithmetick; or the 6th Chap. of Mr. *Oughtred*'s (incomparable) *Clavis Mathematica*; By both which Authors this Rule is largely demonſtrated being grounded upon the 19th Prop. of the 7th, Book of *Euclid. Elem.*

CHAP.

CHAP. XI.

The Single Rule of Three Inverſe.

1. THE Golden Rule, or Rule of three Inverſe, is when there are 3 Numbers given to find a fourth in ſuch proportion to the 3 given Numbers, ſo as the 4th proceeds from the 2d according to the ſame Rate, Reaſon, or Proportion that the firſt proceeds from the third, or the Proportion is,

As the third Number is in proportion to the ſecond, ſo is the firſt to the fourth.

Alſted. Math. lib. 2. cap. 14.

So if the 3 Numbers given were 8, 12, and 16, and it were required to find a fourth Number in an inverted porportion to theſe, I ſay, that as 16 (the third Number) is the double of the firſt Term or Number (8) ſo muſt 12 (the ſecond Number) be the double of the fourth; ſo will you find the fourth Term or Number to be 6. And, as in the Rule of Three direct, you multiply the ſecond and third together, and divide their Product for a fourth Proportional Number.

2. In the Rule of Three Inverſe, you muſt multiply the ſecond Term by the firſt (or firſt Term by the ſecond) and divide the Product thereof by the firſt Term, ſo the Quotient will give you the fourth Term ſought in an inverted Proportion. The ſame order being obſerv'd in this Rule, as in the Rule of Three Direct, for placing and diſpoſing of the given Numbers, and after your Numbers are placed in order, that you may know whether your Queſtion be to be reſolv'd by the Rule Direct or Inverſe, obſerve the general Rule following.

3. When your Queſtion is ſtated, and your Numbers orderly diſpos'd, Conſider, in the firſt place, whether the fourth Term or Number ſought, ought to be more or leſs than the ſecond Term; which you may eaſily do: And if it is requir'd to be more or greater than the ſecond Term, then the leſſer Extream muſt be your Diviſor; but if it require leſs, then the higheſt Ex-

tream muſt be your Diviſor in this Caſe) the firſt and third Numbers are call'd Extreams (in reſpect of the ſecond) and having found out your Diviſor, you may know whether your Queſtion belong to the *Rule Direct* or *Inverſe*; for if the third Term be your Diviſor, then it is a *Direct Rule*. As in the following Queſtions.

Queſt. 1. If 8 Labourers can do a certain Piece of Work in 12 Days, in how many Days will 16 Labourers do the ſame? *Anſwer*, In 6 Days.

Having placed the Numbers according to the ſixth Rule of the tenth Chapter, I conſider, that if 8 Men can finiſh the Work in 12 Days, 16 Men will do it in leſſer or fewer Days than 12) therefore the biggeſt Extream muſt be the Diviſor, which is 16, and therefore it is the *Rule of Three Inverſe* wherefore I multiply the firſt and ſecond Numbers together, *viz.* 8 by 12, and their Product is 96, which divided by 16, quotes 6 Days for the Anſwer, and in ſo many Days will 16 Labourers perform a Piece of Work, when 8 Men can do it in 12 Days.

lab. *days* *lab.*
8——12——16
8
———
16) 96 (6 *days*
96
(0)

Facit 6 *days*

Queſt. 2. If when the Meaſure (*viz.* a Peck) of Wheat coſt 2 Shillings, the Penny-Loaf weighed (according to the Standard Statute, or Law of *England*) 8 Ounces, I demand how much it will weigh when the Peck is worth 1 *s.* 6 *d.* according to the ſame Rate or Proportion? *Anſwer*, 10 *oz.* 13 *p.w.* 8 *gr.*

Having plac'd and reduc'd the given Numbers according to the 6th and 9th Rules of the 10th Chapter, I conſider that at 1 *s.* 6 *d. per* Peck, the Penny-Loaf will weigh more than at 2 *s. per* Peck; for as the Price decreaſeth, the Weight increaſeth; and as the Price increaſeth, ſo the Weight diminiſhes; wherefore becauſe the firſt Term requires more than the ſecond, the leſſer Extream muſt be the Diviſor, *viz.* 1 *s.* 6 *d.* or 18 *d.* and having finiſh'd the Work, I find the Anſwer to be 10 *oz.*

13 *p.w.* 8 *gr.* and ſo much will the Penny-Loaf weigh when the Peck of Wheat is worth 1 *s.* 6 *d.* according to the given Rate of 8 Ounces, when the Peck is worth 2 Shillings. The Work is plain in the following Operation.

s.	oz.	*s.*	*d.*
2	8	1	6
12	24	12	
24	32	18	
	16		

oz. *p.w.* *gr.*
18) 192 (10—13—8

Rem. (12)
20

p.w.
18) 240 (13
18

60
54

(6)
24

18) 144 (8 *gr.*
144

(0)

Queſt. 3. How many pieces of Money or Merchandiſe at 20 *s.* *per* peice, are to be given or received for 240 pieces, the value or price of every piece being 12 ſhillings? *Anſwer*, 144. For if 12 *s.* require 240 pieces, then 20 Shillings will require leſs; therefore the biggeſt Extream muſt be the Diviſor, which is the third Number, *&c.* See the Work.

If

```
       s.  pieces  s.
    If 12—240—20
            12
       ──────────
          480
          240
    2|0)288|0  (144 pieces at 20 s. per piece.
       ──────
           2
       ──────
           8
           8
       ──────
           8
           8
       ──────
          (0)
```

Queſt. 4. How many Yards of 3 quarters broad, are required to double, or be equal in Meaſure to 30 Yards, that are 5 Quarters broad? *Anſwer,* 50 Yards. For ſay, if 5 Quarters wide require 30 Yards long, what length will 3 quarters broad require? Here I conſider that 3 quarters broad will require more Yards than 30, for the narrower the Cloth is, the more in length will go to make equal Meaſure with a broader Piece.

```
 qrs.   long   qrs.
  5 ──── 30 ──── 3
          5
 ──────────────────
 3) 150 (50 y[illegible]
     15
   ──────
    (0)
```

Queſt. 5. At the Requeſt of a Friend, I lent him 200 *l.* for 10 Months: Promiſing to do me the like Courteſy at my Neceſſity; but when I came to requeſt it of him, he could let me have but 150 *l.* now I deſire to know how long I may keep this Money to make plenary Satisfaction for my former Kindneſs to my Friend? *Anſwer,* 16 Months. I ſay, if 200 *l.* will require 12 Months, what will 150 *l.* require? 150 *l.* will require more time than 12 Months, therefore the leſſer Extream (*viz.* 150) muſt be the Diviſor, multiply and divide, and you will find the fourth inverted Proportional to be 16, and ſo many Months I ought to keep the 150 *l.* for Satisfaction.

Queſt. 6. If for 24 *s.* I have 1200 *l.* Weight carry'd 36 Miles, how many Miles ſhall 1800 *l.* be carry'd for the ſame Money? *Anſwer*, 24 Miles.

Queſt. 7. If for 24 *s.* I have 100 *l.* Weight carry'd 36 Miles, how many Pound Weight ſhall I have carry'd 24 Miles for the ſame Money? *Anſwer*, 1800 *l.* Weight.

Queſt. 8. If 100 Workmen in 12 Days finiſh a Piece of Work or Service, how many Workmen are ſufficient to do the ſame in 3 Days? *Anſwer*, 400 Workmen.

Queſt. 9. A Colonel is beſieg'd in a Town in which are 1000 Soldiers with Proviſion of Victuals only for 3 Months, the Queſtion is, How many of his Soldiers muſt he diſmiſs that his Victuals may laſt the remaining Soldiers 6 Months? *Anſwer.* 300 he muſt keep, and diſmiſs as many.

Queſt, 10. If Wine worth 20 *l.* is ſufficient for the Ordinary of 100 Men, when the Tun is ſold for 30 *l.* how many Men will the ſame 20 *l.* worth ſuffice when the Tun is worth 24 *l*? *Anſwer* 125 Men.

Queſt. 11. How much Pluſh is ſufficient to line a Cloak, which hath in it 4 Yards of 7 Quarters wide, when the Pluſh is but 3 Quarters wide? *Anſwer*, $9\frac{1}{2}$ Yards of Pluſh.

Queſt. 12. How many Yards of Canvas that is Ell wide, will be ſufficient to line 20 Yards of Say, that is 3 quarters wide? *Anſwer*, 12 Yards.

Queſt. 13. How many Yards of Matting that is two Foot wide, will cover a Floor that is 24 Foot long, and 20 Foot broad? *Aaſwer*, 240 Foot.

Queſt. 14. A Regiment of Soldiers conſiſting of 1000, are to have new Coats, and each Coat to contain 2 Yards 2 quarters of Cloth, that is 5 quarters wide, and they are to be lined with Shalloon that is 3 quarters wide, I demand how many Yards of Shalloon will line them? *Anſwer*, $16666\frac{2}{3}$ quarters, or $4166\frac{3}{4}$ Yards.

Queſt. 15. A Meſſenger makes a Journey in 24 Day when the Day is 12 Hours long. I deſire to know i how many Days he will go the ſame when the Day i 16 Hours long; *Anſwer*, In 18 Days.

Queſt. 16. I borrowed of my Friend, 64 *l.* for 6 Months, and he hath occaſion another time to borrow of me for 12 Months, I deſire to know how much I muſt lend to make good his former Kindneſs to me *Anſwer*, 42 *l.* 13 *s.* 4 *d.*

4. The general Effect of the *Rule of* 3 *Inverſe*, is contained in the Definition of the ſame, that is, to find a fourth Term in a Reciprocal proportion inverted to the proportion given.

The ſecond Effect is, by two prices or Values of two ſeveral pieces of Money or Merchandizes known, to find how many Pieces of the one price is to be given for ſo many of the other. And conſequently to reduce and exchange one ſort of Money or Merchandize into another. Or contrariwiſe, to find the price unknown of any piece given to exchange in Reciprocal proportion.

The third effect is, by two different prices of a Meaſure of Wheat bought or ſold, and the Weight of the Loaf of Bread, made anſwerable to one of the prices of the Meaſure given, to find out the Weight of the ſame Loaf anſwerable to the other price of the ſaid Meaſure given. Or contrariwiſe, by the two ſeveral Weights of the ſame priced Loaf, and the price of the Meaſure of Wheat anſwerable to one of thoſe Weights given, to find out the other price of the Meaſure anſwerable to the other Weight of the ſame Loaf.

The fourth Effect, is, by two Lengths, and one Breadth of two Rectangular plains known, to find out another Breadth unknown. Or by two Breadths and one Length given, to find out another Length unknown in an Inveated proportion.

The fifth Effect, is, by double Time; and a capital Sum of Money borrowed or lent, to find out another capital Sum anſwerable to one of the given Times, r otherwiſe, by two capital Sums, and a Time anwerable to one of them given, to find out a Time anwerable to the other capital Sum in reciprocal Reaſon.

The ſixth Effect is, by two different Weights of Carriage, and the diſtance of the Place in Miles or in Leagues given, to find another diſtance in Miles anſwerable to the ſame price of Payment; Or otherwiſe, by two diſtances in Miles, and the Weight anſwerable to one of the diſtances (being carry'd for a certain price) to find out the Weight anſwerable to the other diſtance for the ſame price.

The ſeventh Effect, is, by double Workmen, and the Time anſwerable to one of the Numbers of Workmen given, to find out the Time anſwerable to the other Number of Workmen, in the performance of any Work or Service. Or contrariwiſe, by double Time, and the Workmen anſwerable to one of thoſe Times given, to find out the Number of Workmen anſwerable to the other Time, in the performance of any Work or Service.

Alſo by a double price of Proviſion, and the number of Men, or other Creatures nouriſh'd for a certain Time anſwerable to one of the prices of Proviſions given, to find out another number of Men or other Creatures anſwerable to the other price of the Proviſion for the ſame Time. Or contrariwiſe, by two Numbers of Proviſion anſwerable to one of the Numbers of Creatures given, to find out the other price of the ſame Proviſion anſwerable to the other number of Creatures, both being ſuppos'd to be nouriſh'd for the ſame, *&c.* as in the foregoing Examples is fully declar'd.

To prove the Operation of the *Rule of Three Inverſe*, multiply the third and fourth Terms together, and note their product; and multiply the firſt and ſecond together, and if their product is equal to the product of the third and fourth, then is the Work truly wrought, but if it falleth otherwiſe, then it is erroneous.

As in the firſt Queſtion of this Chapter, 16 (the third Number) being multiply'd by 6 (the fourth Number) the Product is 96, and the Product of 8 (the firſt Number) multiply'd by 12 (the ſecond Number) is 96 equal to the firſt Product, which proves the Work to be right.

And note, that if in Diviſion any thing remain, ſuch Remainder muſt be added to the Product of the third and fourth Terms, and if the Sum be equal to the Product of the firſt and ſecond (the Homogenial Terms being of one Denomination) the Work is right.

CHAP. XII.

The Double Rule of Three Direct.

WE have already deliver'd the Rule of Single Proportion, and we come now to lay down the Rules of Plural Proportion.

1. Plural Proportion, is, when more Operations in the Rule of Three than one, are requir'd before a Solution can be given to the Queſtion propounded. Therefore in Queſtions that require plurality in Proportion, there are always given more than 3 Numbers.

2. When there are given 5 Numbers, and a ſixth is required in Proportion thereunto, then this ſixth Proportional is ſaid to be found out by the Double Rule of Three, as in the Queſtion following, *viz.*

If 100 *l.* in 12 Months, gain 6 *l.* Intereſt, how much will 75 *l.* gain in 9 Months?

3. Queſtions in the Double Rule of Three may be reſolved either by two Single Rules of Three, or by one *Single Rule of Three,* compounded of the 5 given Numbers.

4. *The Double Rule of Three* is either *Direct,* or elſe *Inverſe.*

5. *The Double Rule of Three Direct,* is, when unto 5 given Numbers, a ſixth Proportional may be found out by two *Single Rules of Three Direct.*

6. The 5 given Numbers in the Double Rule of

Three Direct conſiſts of two Parts, *viz.* Firſt a Suppoſition, and Secondly, of a Demand : the Suppoſition is contain'd in the three firſt of the five given Numbers, and the Demand lies in the two laſt ; as in the *Example* of the ſecond Rule of this Chapter, *viz.* if 100 *l.* in 12 Months gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months ? Here the Suppoſition is expreſs'd in 100, 12, and 6 ; for it is ſaid if 100 *l.* in 12 Months gain 6 *l.* Intereſt : And the Demand lieth in 75 and 9 ; for it is demanded, how much 75 *l.* will gain in 9 Months ?

7. When your Queſtion is ſtated, the next Thing will be to diſpoſe of the given Numbers in due order and place, as a Preparative for Reſolution ; which that you may do ; Firſt, obſerve which of the given Numbers in the Suppoſition is of the ſame Denomination with the Number requir'd ; for that muſt be the ſecond Number (in the firſt Oporation) of the Single Rule of Three, and one of the other Numbers in the Suppoſition (it matters not which) muſt be the firſt Number, and that Number in the Demand which is of the ſame Denomination with the firſt, muſt be the third Number ; which three Numbers being thus plac'd, will make one perfect Queſtion in the Single Rule of Three, as in the fore-mention'd *Example* : Firſt, I conſider that the Number requir'd in the Queſtion, is the Intereſt or Gain of 75 *l.* therefore that Number in the Suppoſition which hath the ſame Name (*viz.* 6 *l.*) which is the Intereſt or Gain of 100 *l.* muſt be the ſecond Number in the firſt Operation, and either 100, or 12 (it matters not which) muſt be the firſt Number ; but I will take 100, and then for the third Number I put that Number in the Demand, which hath the ſame Denomination with 100. which is 75, (for they both ſignify Pounds principal) and then the Numbers will ſtand as you ſee in the Margent.

100—6—75

But if I had for the firſt Number put the other Number in the Suppoſition, *viz.* 12, which ſignifies 12 Months, then the third Number muſt have been 9, which is that Number in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 Months; and then they will ſtand as in the Margent.

100—*6*—9

There yet remain two Numbers to be diſpoſs'd of, and thoſe are one in the Suppoſition, and another in the Demand; that which is of the Suppoſition, I place under the firſt of the three Numbers, and the other, which is the Demand, I place under the third Number; and then two of the Terms in the Suppoſition will ſtand (one over the other) in the firſt place, and the two Terms in the Demand, will ſtand (one over another) in the third place, as in in the Margent.

100—*6*—75
12 9

Or this,

12—*6*—9
100 9

8. Having diſpos'd or order'd the Numbers given according to the laſt Rule, we may proceed to a Reſolution; and firſt I work with the 3 uppermoſt Numbers, which according to the firſt diſpoſition are 100, *6*, and 75, which is as much as to ſay, if 100 *l.* require 6 *l.* (Intereſt) how much will 75 *l.* require? which by the 3d Rule of the 11th Chapter, I find to be Direct, and by the 7th and 8th Rules of the 10th Chapter, I find the 4th Proportional Number to be 4 *l.* 10 *s.* ſo that by the foregoing ſingle Queſtion I have diſcover'd how much Intereſt 75 *l.* will gain in 12 Months; the Operation whereof followeth on the Left-hand under the Letter A, and having diſcover'd how much 75 *l.* will gain in 12 Months, we may by another Queſtion eaſily diſcover how much it will gain in 9 Months; for this 4th Number (thus found) I put in the middle between the two loweſt Numbers of the 5, after they are place according to the 7th Rule of this Chapter; and then it will be a 2d Number, in another Queſtion in the *Rule of Three.*

m. l. s. m.
The Numbers being 12—4—10—9 the firſt and third Num-

Numbers being of one Denomination, *viz.* both Months, and may be thus expreſs'd; If 12 Months require 4 *l.* 10 *s.* Intereſt, what will 9 Months require? And by the 3d Rule of the 11th Chapter, I find it to be the *Direct Rule*, and by working according to the Directions laid down in the 7th, 8th and 9th Rules of the 10th Chapter, I find the fourth Proportional Number to the laſt ſingle Queſtion, to be 3 *l.* 7 *s.* 6 *d.* which is the ſixth Proportional Number to the 5 given Numbers, and is the Anſwer to the general Queſtion. The Work of the laſt ſingle Queſtion is expreſs'd on the right-ſide of the Page under the Letter B, as followeth.

100
A 12
l. l. l.
If 100 6 75
75
30
42
l. *s.*
1|00) 4|50 (4--10
4
Rem. (50)
Mult. 20
1100 (10|00 (10 *s.*

l. *s.*
Facit 4 ---- 10

---- 6 ---- 75
9 B
Then ſay,
m *l.* *s.* *m.*
If 12 ---- 4 ---- 10 ---- 9
20
90 *ſhillings*
12
180
90
1080 *pence*
9
12) 2|0 *l.* *s.* *d.*
12) 9720 (810 (67 (3--7--6.
99 72
(7 *s.*
12 90
12 84

(0) (6) *Pence*

l. *s.* *d.*
Facit 3 -- 7 -- 6

So that by the foregoing Operation I conclude, that if 100 *l.* in 12 Months, gain 6 *l.* Intereſt, 75 will gain 3 *l.* 7*s.* 6*d.* in 9 Months after the ſame rate, the Anſwer would have been the ſame if the 5 given Numbers had been ordered according to the ſecond Method, *viz.* as you ſee in the Margent.

12—6—9
100—..75

For firſt, I ſay, if 12 Months gain 6 *l.* what will 9 Months gain? This Queſtion I find to be direct by the 3d Rule of the 11th Chapter, and by the 7th and 8th Rules of the 10th Chapter, I find the fourth Proportional Number to theſe three to be 4 *l.* 10 *s.*

Thus I have found out what is the Intereſt of 100 *l.* for 9 Months, and I am now to find the Intereſt of 75 *l.* for 9 Months, to effect which, I make this 4th Number (found as before) to be my ſecond Number in the next Queſtion, and ſay, if 100 *l.* require 4 *l.* 10 *s.* what will 75 *l.* require? This Queſtion I find (by the ſaid 3d Rule of the 11th Chapter) to be Direct, and by the ſaid 7th, 8th, and 9th Rules of the 10th Chapter, I find the Anſwer to be as before, *viz.* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been ſufficiently explain'd by the foregoing Example, ſo that the Learner may be able to reſolve the following (or any other) queſtions pertinent to the *Double Rule of Three Direct*, whoſe Anſwers are there given, but the Operations are purpoſely omitted, to try the Learner's Ability in the Knowledge of what has been before deliver'd.

Queſt. 2. A ſecond Example in this Rule may be as followeth, *viz.* A Carrier receiving 42 Shillings for the Carriage of 300 Weight 150 Miles, I demand how much he ought to receive for the Carriage of 7 C. 3 *qrs* 14 *l.* 50 Miles at that rate? *Anſwer*, 36 *s.* 9 *d.*

Queſt. 3. A Regiment of 936 Soldiers eat up 351 quarters of Wheat in 108 Days; I demand how many quarters of Wheat 11232 Soldiers will eat in 56 Days at that rate? *Anſwer*, 1404 quarters.

Queſt. 4. If 40 Acres of Graſs be mowed by 8 Men in 7 Days, how many Acres ſhall be mowed by 24 Men in 28 Days? *Anſwer*, 480 Acres.

Queſt. 5. If 48 Buſhels of Corn (or other Seed) yield 576 Buſhels in a Year, how much will 240 Buſhels yield in 6 Years at that Rate; that is to ſay, if there were ſowed 240 Buſhels every one of the 6 Years; *Anſwer*, 17280 Buſhels.

Queſt. 6. If 40 Shillings is the Wages of 8 Men for 5 Days, what will be the Wages of 32 Men for 24 Days? *Anſwer*, 768 Shillings, or 38 *l.* 8 *s.*

Queſt. 7. If 14 Horſes eat 56 Buſhels of Provender in 16 Days, how many Buſhels will 20 Horſes eat in 24 Days? *Anſwer*, 120 Buſhels.

Queſt. 8. If 8 Cannons in one Day ſpend 48 Barrels of Powder, I demand how many Barrels 24 Cannons will ſpend in 22 Days at that Rate? *Anſwer*, 1728 Barrels.

Queſt. 9. If in a Family conſiſting of 7 Perſons, thete are drunk out 2 Kilderkins of Beer in 12 Days, how many Kilderkins will there be drunk out in 8 Days by another Family conſiſting of 14 Perſons? *Anſwer*, 48 Gallons, or 2 Kilderkins and 12 Gallons.

Queſt. 10. An Uſurer put 75 *l.* out to receive Intereſt for the ſame, and when it had continu'd 9 Months he received for Principal and Intereſt 78 *l.* 7 *s.* 6 *d.* I demand at what Rate *per Cent. per Annum*, he received Intereſt? *Anſwer*, 6 *l. per Cent. per Annum.*

CHAP. XIII.

The Double Rule of Three Inverſe.

1. THE *Double Rule of Three Inverſe*, is, when a Queſtion in the *Double Rule of Three* is reſolv'd by two *Single Rules of Three*, and one of thoſe *Single Rules* falls out to be *Inverſe*, or requires a fourth Number in *Proportion Reciprocal* (for both Queſtions are never *Inverſe*.)

2. In all Queſtions of the *Double Rule of Three* (as well *Inverſe* as *Direct*) you are in the diſpoſing of the 5

given Numbers) to obſerve the 7th Rule of the 12th Chapter, and in reſolving of it by two Single Rules, obſerve to make choice of your Numbers for the firſt and ſecond ſingle Queſtions, according to the Directions given in the 8th Rule of the ſame Chapter, as in the Example following, *viz.*

Queſt. 2. If 100 *l.* Principal in 12 Months, gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months?

This Queſtion is an Inverſion of the firſt Queſtion of the 12th Chapter, and may ſerve for a Proof thereof.

In order to a Reſolution, I diſpoſe of the 5 given Numbers according to the 7th Rule of the laſt Chapter; and being ſo diſpos'd, they will ſtand as followeth.

12 ———————— 100 ———————— 9
6 *l.* *s.* *d.*
3—7—6

Or thus,

l. *s.* *d.*
6 ———————— 100 ———————— 3—7—6
12 9

Here obſerve, That according to the 8th Rule of the 12th Chapter, the firſt Queſtion, if you take it from the 5 Numbers (as they are ordered or placed firſt) will be, if 12 Months require 100 *l.* principal, what will 9 Months require to make the ſame Intereſt? This (according to the 3d Rule of the 11th Chapter) is *Inverſe*, and the Anſwer will be found (by the 2d Rule of the 11th Chapter) to be 133 *l.* 6 *s.* 8 *d.* The 2d Queſtion then will be. If 6 *l* Intereſt require 133 *l.* 6 *s.* 8 *d.* Principal, how much Principal will 3 *l.* 7 *s.* 6 *d.* require? This is a Direct Rule, and the Anſwer in a Direct Proportion, is 75 *l.* See the Work.

First I ſay,

```
    m.      l.      m.
If 12 —— 100 —— 9
           12
       ———————      l.   s.  d.
    9) 1200 (133—6—8
           ...
                         l.  s.  d.
           9
       ——————— Fac. 133—6—8
           30
           27
       ———————
           30
           27
       ———————
          (3)
           20
     9) 60 (6 s.
           54
       ———————
          (6)
           12
       ———————
     9) 72 (8 d.
           72
       ———————
          (0)
```

Then I ſay,

```
 l.     l.      s.   d.    l.     s.      d.
If 6——133 ——6——8 ——3——7 ——6
240 —— 20                  20
_______________          _________
1440 d. 2666               67
          12               12
        _____            _______
        5340              140
        2666               67
      ________          _________
       32000              810 d.
         810
      _________
       320000
       256
      ______________24||0
144|0) 2592000|0 (18000||0 d. or 75 l.
        ....         ..
        144         168
      ______      _______
        1152        120
        1152        120
      ______      _______
        (0)         (0)
```

So that by the foregoing Work I find that if 6 *l.* Intereſt be gain'd by 100 *l.* in 12 Months, 3 *l.* 7 *s.* 6 *d.* will be gain'd by 75 *l.* in 9 Months.

But if the Reſolution had been found out by the Numbers as they are ranked in the ſecond place, then the ſecond queſtion in the Single Rule would have been *Inverſe* and the firſt queſtion *Direct*, and the concluſion the ſame with the firſt Method, *viz.* 75 *l.*

Queſt. 2. If a Regiment conſiſting of 936 Soldiers can eat up 351 quarters of Wheat in 168 Days, how many Soldiers will eat up 1404 quarters in 56 Days at that Rate? *Anſwer*, 11232 Soldiers.

Queſt. 3. If 12 Students in 8 Weeks ſpend 48 *l.* I demand how many Students will ſpend 288 *l.* in 18 Weeks? *Anſwer*, 32 Students.

Queſt. 4. If 48 *l.* ſerve 12 Students 8 Weeks, how many Weeks will 288 *l.* ſerve 4 Students? *Anſwer*, 144 Weeks.

Queſt. 5. If when the Buſhel of Wheat coſt 3 *s.* 4 *d.* the Penny-Loaf weigheth 12 Ounces, I demand the Weight of the Loaf worth 9 *d.* when the Buſhel coſt 10 *s.* *Anſwer*, 36 Ounces.

Queſt. 6. If 48 Pioneers in 12 Days caſt a Trench 24 Yards long; how many Pioneers will caſt a Trench 168 Yards long in 16 Days? *Anſwer*, 252 Pioneers.

Queſt. 7. If 12 C. Weight being carry'd 100 Miles, coſt 5 *l.* 12 *s.* I deſire to know how many C. Weight may be carry'd 150 Miles for 12 *l.* 12 *s.* at that Rate? *Anſwer*, 18 C.

Queſt. 8. If when Wine is worth 30 *l.* *per* Tun, 20 *l.* worth is ſufficient for the Ordinary of 100 Men, how many Men will 4 *l.* worth ſuffice when it is worth 24 *l* *per* Tun? *Anſwer*, 25 Men.

Queſt. 9. If 6 Men in 24 Days Mow 72 Acres; in how many Days will 8 Men Mow 24 Acres? *Anſwer*, in 6 Days.

Queſt. 10. If when the Tun of Wine is worth 30 *l.* 100 Men will be ſatisfy'd with 20 *l.* worth, I deſire to know what the Tun is worth when 4 *l.* worth will ſatisfy 25 Men at the ſame Rate? *Anſwer*, 24 *l.* *per* Tun.

CHAP. XIV.

The Rule of Three Compos'd of Five Numbers.

THE *Rule of Three Compos'd*, is, when Queſtions (wherein there are 5 Numbers given to find a 6th in Proportion thereunto) are reſolv'd by one *Single Rule of Three* compos'd of the 5 given Numbers.

2. When Queſtions may be perform'd by the *Double Rule of Three Direct*, and it is requir'd to reſolve them by the *Rule of Three Compos'd*; firſt, order or rank your Numbers according to the 7th Rule of the 12th Chapter; then,

The Rule is,

Multiply the terms or numbers) that ſtand one over the other in the firſt place, the one by the other, and make their Product the firſt Term in the *Rule of Three Direct*; then multiply the Terms that ſtand one over the other, in the third place, and place their Product for the third Term, in the *Rule of Three Direct*, and put the middle Term of the 3 uppermoſt for a ſecond Term, then having found a fourth Proportional direct to theſe three, this fourth Proportional ſo found ſhall be the Anſwer requir'd.

So the firſt Queſtion of the 12th Chapter being propos'd, *viz.* If 100 *l.* in 12 months, gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months? The numbers being rank'd (or plac'd) as is there directed and done.

Then I multiply the two firſt Terms, 100 and 12 the one by the other, and their Product is 1200 (for the firſt Term) then I multiply the two laſt Terms 75 and 9 together, and their Product is 675 for the third Term. Then I ſay, as 1200 is to 6, ſo is 675 to the Anſwer, which by the *Rule of Three Direct*, will be found to be 3 *l.* 7 *s.* 6 *d.* as was before found.

3. But if the Queſtion be to be anſwer'd by the *Double Rule of Three Inverſe*, then (having placed the five given Terms as before) multiply the lowermoſt Term, of the Firſt place, by the uppermoſt Term of the third place, and put the Product for the firſt Term, then multiply the uppermoſt Term of the firſt place, by the lowermoſt Term of the third place, and put the Product for the third Term, and put the ſecond Term of the three higheſt numbers for the middle Term to thoſe two, then if the Inverſe Proportion is found in the uppermoſt three numbers, the *4th Proportional Direct* to theſe three ſhall be the Anſwer. So the firſt Queſtion of the 13*th* Chapter being ſtated, *viz.* If 100 *l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months? State the numbers as is there directed in the firſt order, *viz.*

M. L. M.
12——100——9
l. l. s. d.
6 3—7—6

The reduce the 6 *l.* and 3 *l.* 7 *s.* 6 *d.* into Pence, the 6 *l.* is 1440 *d.* and 3 *l.* 7 *s* 6 *d.* is 801 *d.* then multiply 1440 by 9, the Product is 12960 for the firſt Term in the *Rule of Three Direct*, and multiply 810 by 12, the Product is 9720, for the third Term; then I ſay, as 12960 is to 139 *l.* ſo is 9720 to the Anſwer, *viz.* 75 *l.* as before. But if the Terms had been placed after the ſecond Order, *viz.*

l. l. l. s. d.
6——100——3——7——6
M. M.
12 9

Then the *Inverſe Proportion* is found in the loweſt Numbers, and having compoſ'd the Numbers for a *Single Rule of Three*, as in the ſecond Rule foregoing, then the Anſwer muſt be found by a *Single Rule of Three Inverſe*; for here it falls out to multiply 810 by 12 for the firſt Number and 1440 by 9 for the third Number; and then you muſt ſay, As 9720 is to 100 *l.* ſo is 12960 to the Anſwer, which by *Inverſe Proportion* will be found to be 75 *l.* as before.

The Queſtions in the 12th and 13th Chapters may ſerve for thy farther Experience.

CHAP. XV.

Single Fellowſhip.

FELLOWSHIP, is that Rule of Plural Proportion, whereby we Ballance Accompts depending between divers Perſons having put together a General Stock, ſo that they may every Man have his proportional part of Gain, or ſuſtain his proportional part of Loſs.

2. The Rule of Fellowſhip, is either Single or it is Double.

3. The Single Rule is, when the Stocks propounded are Single Numbers, without any reſpect or relation to Time, each Partner continuing his Money in Stock for the ſame Time.

4. In the Single Rule of Fellowſhip, the Proportion is, as the whole Stock of all the Partners is in Proportion to the total Gain or Loſs, ſo is each Man's particular Share in the Stock, to his particular Share in the Gain or Loſs. Therefore take the Total of all the Stocks for the firſt Term in the Rule of Three, and the whole-Gain or Loſs for the ſecond Term, and the particular Stock of any one of the Partners for the 3d Term, then multiply and divide according to the 7th Rule of the 9th Chapter, and the fourth Proportional Number is the particular Loſs or Gain of him, whoſe Stock you made your ſecond Number, wherefore repeat the Rule of Three as often as there are particular Stocks or Partners in the Queſtion, and the fourth Terms produced upon the ſeveral Operations, are the reſpective Gain or Loſs of thoſe particular Stocks given, as in the Examples following.

Queſt. 1. Two Perſons, *viz.* A and B bought a Tun of Wine for 20 *l.* of which A paid 12 *l.* and B paid 8 *l.* and they gain'd in the Sale thereof 5 *l.* now I demand each Man's Share in the Gains according to his Stock.

Firſt, I find the Sum of all their Stocks, by adding them together, *viz.* 12 *l.* and 8 *l.* which are 20 *l.* then according to this Rule, I ſay firſt, If 20 *l.* (the Sum of their Stock) require 5 *l.* the total Gain, how much will 12 *l.* (the Stock of A) require? Multiply and divide by the 7th Rule of the 9th Chapter, and the Anſwer is 3 *l.* for the Share of A in the Gains;

$$\begin{array}{r} 12 \\ 8 \\ \hline 20\ l. \end{array}$$

Gains; Then again, I ſay, If 20 *l.* require 5 *l.* what will 8 *l.* require? The Anſwer is 2 *l.* which is the Gain of B. So I conclude that the Share of A in the Gain is 3 *l.* and the Share of B in the Gain is 2 *l.* which in all is 5 *l.*

l. *l.* *l.*
If 20 ——— 5 ——— 12
12
———
20) 60 (3 *l.*
60
———
(0)

l. *l.* *l.*
If 20 ——— 5 ——— 8
8
———
20) 40 (2 *l.*

Queſt. 2. Three Merchants, *viz.* A, B, and C, enter upon a joynt Adventure; A put into the common Stock 78 *l.* B put in 117 *l.* and C put in 234 *l.* and they find (when they made up their Accompts) that they have gain'd in all 264 *l.* now I deſire to know each Man's Share in the particular Gain.

Firſt, I add their particular Stocks together; and their Sum is 429 *l.* then ſay, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? and what 117 *l.* and what will 234 *l.* (the Stocks of A, B, and C) gain? Work by three ſeveral *Rules of Three*, and you will find that

l.
78
117
234
———
Sum 429

The Gain of A is 48
The Gain of B is 72
The Gain of C is 144
———
Sum 264

Queſt. 2. Four Partners, *viz.* A, B, C and D, between them built a Ship which coſt 1730 *l.* of which A paid 346 *l.* B 519, C 692 *l.* and D 172 *l.* and her Freight for a certain Voyage is 370 *l.* which is due to the Owners or Builders. I demand each Man's Share therein according to his Charge in building her?

Anſwer,

A	74
B	111
C	148
D	37
Sum	370

Queſt. 4. A, B and C enter Partnerſhip for a certain time, A put into the Common Stock 364 *l.* B put in 482 *l.* C put in 50 *l.* and they gain'd 867 *l.* now I demand each Man's Share in the Gain, proportionable to his Stock?

Anſwer,

	l.	*s.*	*d*
A	234	09	$3\frac{154}{1346}$
B	310	09	$5\frac{62}{1346}$
C	322	01	$3\frac{930}{1346}$
Sum	867	00	0

The Proof of the Rule of Single Fellowſhip.

5. To prove the Rule of Single Fellowſhip, add each Man's particular Gain or Loſs together, and if the Total Sum is equal to the general Gain or Loſs, then is the Work rightly perform'd, but otherwiſe it is erroneous. *Example*: In the firſt Queſtion of this Chapter; the *Anſwer* was, That the Gain of A was 3 *l.* and the Gain of B 2 *l.* which added together makes 5 *l.* equal to the Total Gain given.

If in finding out the *particular Shares* of the ſeveral *Partners*, any thing remain after Diviſion is ended, ſuch Remainders muſt be added together, (they being all Fractions of the ſame Denominations)and their Sum divided by the common Diviſor in each Queſtion (*viz.* the total Stock) and the Quotient add to the particular Gains, and then if the total Sum is equal to the total Gain, the Work is right, otherwiſe not.

As in the Fourth Queſtion, the Remainders were 354, 62 and 930, which added together make 1346, which divided by 1346, (the Sum of their Stocks) the Quotient is 1 *d.* which I add to the Pence, *&c.* and the Sum of their Share is 867 *l* equal to the total Gain, wherefore I conclude the Work is right.

CHAP. XVI.

Double Fellowſhip.

1. DOuble Fellowſhip is when ſeveral Perſons enter into Parternerſhip for unequal Time, that is, when every Man's particular Stock hath Relation to a particular Time.

2. In the *Double Rule of Fellowſhip*, multiply each particular Stock by its reſpective Time, and having added the ſeveral Products together, make their Sum the firſt Number (or Term in the Rule of 3, and the total Gain or Loſs the ſecond Number, and the Product of any one's particular Stock by his time, the third Term) and the 4th Number in proportion thereunto is his particular Gain or Loſs whoſe Product of Stock and Time is your Third Number.

Then repeat (as in *Single Fellowſhip*) the *Rule of* 3, as often as there are Products or (Partners) and the Terms thereby invented, are the Numbers required.

Example.

Queſt. 1. A and B enter Partnerſhip; A put in 40 *l.* for 3 Months, B put in 75 *l* for 4 Months, and they gain'd 70 *l.* now I demand each Man's Share in the Gain proportional to his Stock and Time? *Anſwer*, A 26 *l.* B 50 *l.*

To reſolve this Queſtion, I firſt multiply the Stock of A, (*viz.* 40 *l.*) by its Time (3 Months) and the product is 120; then I multiply the Stock of B by its Time, (*viz.* 75 *l.* by 4) and it produceth 300, which I add to the Product of A, his Stock and Time, and the Sum is 420. Then by the *Rule of Three Direct*, I ſay, As 420 (the Sum of the Product is to 70 the Total Gain) ſo is 120 (the Product of A his Stock and Time) to 20 *l.* (the Share of A in the Gain.) Then I ſay again, As 420 is to 70, ſo is 300 to 50 *l.* (the Share of B in the Gains.) And ſo much ought each to have for his Share.

	l.		*l.*
	40		75
	3		4
A	120	B	300
			120
		Sum	420

Queſt. 2. A, B and C make a Stock for 12 Months, A put in at firſt 364 *l.* and 4 Months after that he put in 40 *l.* B put in at firſt 408 *l.* and at the End of 7 Months he took out 86 *l.* C put in at firſt 148 *l.* and 3 Months after he put in 86 *l.* more, and 5 Months after that he put in 100 *l.* more, and at the End of 12 Months their Gain is found to be 1435 *l.* I deſire to know each Man's Share in the Gains, according to his Stock and Time?

Firſt, I conſider that the whole Time of their Partnerſhip is 12 Months. Then I proceed to find out the ſeveral Products, or Stock and Time as followeth:

A had at firſt 364 *l.* for 4 Months wherefore their Product is,	1456
Then he put in 40 *l.* which with the firſt Sum makes 404 *l.* which continued the remainder of the Time, *viz.* 8 Months, and their Product is,	3232
The Sum of the Products of the Stock and Time of A is,	4688

B had

B had 408 *l.* in 7 Months, whoſe Product is	2856
And then took out 86 *l.* therefore he left in Stock 322 *l.* which continued the reſt of the time, *viz.* 5 Months whoſe Product is,	1510
The Sum of the Products of the Stock and Time of B is,	4466
C put in 148 *l.* for 3 Months, whoſe Product being multiply'd is,	444.
Then he put in 86 *l.* which added to the firſt (*viz.* 148 *l*) makes 234 *l.* which lay in Stock 5 Months, their Product is,	1170
Then he put in 100 *l.* more, ſo then he had in Stock 334 *l.* which continued the remainder of the time, (*viz.* 4 Months) which multiply'd together produce,	1336
The Sum of the Product of the Money and Time of C is,	2950
B	4466
A	4688
The total Sum of all the Products is,	12104

Then I ſay, as 12104 is to 1436 (the total Gain) ſo is 2950 to the ſhare of A in the Total Gain, *&c.* go on as in the foregoing Examples, and you will find their Shares in the Gain to be as followeth, *viz.*

Anſwer.

The Share of A is 556—03—$6\frac{6192}{12104}$

The Share of B is 529—16—$9\frac{5496}{12104}$

The Share of C is 249—10—$8\frac{416}{12104}$

1456—00—00

Queſt. 3. Three Graſiers, A, B, and C take a piece of Ground for 46 *l.* 10 *s.* in which A put 12 Oxen for 8 Months, B put in 16 Oxen for 5 Months, and C put 18 Oxen for 4 Months, now the Queſtion is, what each Man ſhall pay of the 46 *l.* 10 *s.* for his Share in that Charge.

Anſwer,

		l.	*s.*
A	ſhall pay	18	00
B		15	00
C		13	10
		46	10

3. The Proof of this Rule is the ſame with that of *Single Fellowſhip*, laid down in the 5th Rule of the 15th Chapter; and Note, that

If a Loſs be ſuſtained inſtead of Gain amongſt Partners every Man s Share to be born in the Loſs is to be found after the ſame Method as their Gain, whether their Stocks be for equal or unequal Time.

CHAP. XVII.

Alligation Medial.

1. THE Rule of Alligation is that Rule in Plural Proportion by which we reſolve Queſtions, wherein is a Compoſition or Mixture of diverſe Simples, as alſo it is uſeful in Compoſition of Medicines both for quantity, quality and price. And its Species are two, *viz.* Medial and Alternate.

2. Alligation Medial, is, when having the ſeveral Quantities and Prices of ſeveral Simples propounded, we diſcover the mean Price or Rate of any quantity of the Mixture compounded of thoſe Simples, and the proportion is,

As the Sum of the Simples to be mingled is to the total Value of all the Simples, ſo is any Part or Quantity of the Compoſition or Mixture to its mean Rate or Price.

Queſt. 1. A Farmer mingled 20 Buſhels of Wheat at 5 *s. per* Buſhel, and 36 Buſhels of Rye at 3 *s. per* Buſhel, with 40 Buſhels of Barley at 2 *s. per* Buſhel; now I deſire to know what one Buſhel of that Mixture is worth?

To reſolve this Queſtion, add together the given Quantities, and alſo their Values, which is 96 Buſhels, whoſe total Value is 14 *l.* 8 *s.* as appeareth by the Work following; for,

	Buſh.		*l.*	*s.*
	20	*of Wheat at* 5 *s.* per *Buſhel, is*	5	0
	36	*of Rye at* 3 *s.* per *Buſhel, is*	5	8
	47	*of Barley at* 2 *s.* per *Buſhel, is*	4	0
The Sum of their given quantities is	96,	*and their Value is,*	14	8

Then ſay by the Rule of 3 Direct, If 96 Buſhels coſt (or is worth 14 *l.* 8 *s.*) What is 1 Buſhel worth?

buſh. *l.* *s.* *buſh.*
96 — 14 — 8 — 1
20

96) 288 (3 *s.*

288 *Facit,* 3 *s. per Buſhel.*
(0)

Queſt. 2. A Vintner mingleth 15 Gallons of Canary at 8 *s. per* Gallon, with 18 Gallons of Malaga, at 7 *s.* 4 *d. per* Gallon, with 10 Gallons of Sherry, at 6 *s.* 0 *d. per* Gallon, and 24 Gallons of White-wine, at 4 *s. per* Gallon; now I demand what a Gallon of this Mixture is worth? Work as in the laſt Queſtion, and you will find the Anſwer to be 6 *s.* 2 *d.* 2 *qrs.* $\frac{46}{67}$.

Queſt. 3. A Grocer hath mingled 3 C. of Sugar at 56 *s. per* C. with 3 C. of Sugar at 3 *l.* 14 *s* 8 *d. per* C. and with 6 C at 1 *l.* 17 *s.* 4 *d. per* C. I deſire to know the price of a Hundred Weight of that Mixture?

Anſwer, 2 *l.* 13 *s.* 1 *d.* $\frac{7}{13}$.

The Proof of Alleg. Medial.

3. The proof of this Operation, is by the price of any Quantity of the Mixture to find out the total Value of the whole Compoſition, and if it is equal to the total Value of the ſeveral Simples, the Work is right; otherwiſe not. As in the firſt Example, the Anſwer to the Queſtion was, That 3 *s.* is the price of one Buſhel; wherefore I ſay, by the Rule of Proportion, If 1 Buſhel be 3 *s.* what is 96 Buſhels? *Anſwer,* 14 *l.* 8 *s* which is the total Value of the ſeveral Simples: Wherefore the Work is right.

CHAP. XVIII.

Alligation Alternate.

1. ALLIGATION *ALTERNATE*, is, when there are given the particular prices of ſeveral Simples, and thereby we diſcover ſuch Quantities of thoſe Simples, as being mingled together, ſhall bear a certain Rate propounded.

2. When ſuch a Queſtion is ſtated, place the given Prices of the Simples one over the other, and the propounded price of the Compoſirion againſt them in ſuch ſort that it may repreſent a Root, and they as ſo many Branches ſpringing from it, as in the following *Examp.*

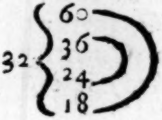
Queſt. 1. A certain Farmer is deſirous to mix 20 Buſhels of Wheat at 5 *s.* or 60 *d. per* Buſhel, with Rye at 3 *s.* or 36 *d. per* Buſhel, and with Barley at 2 *s.* or 24 *d. per* Buſhel, and Oats at 1 *s.* 6 *d. per* Buſhel, and deſireth to mix ſuch a Quantity of Rye Barly and Oats with the 20 Buſhels of Wheat, as that the whole Compoſition may be worth 2 *s.* 8 *d*, or 32 *d. per Buſhel.*

The Prices of the Simples being placed according to the laſt Rule (with the price of the *Compoſition* propounded as a Root to them) will ſtand as followeth

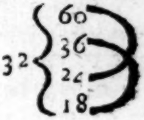
$$32\begin{cases}60\ \textit{Pence}\\36\\24\\18\end{cases}$$

3. Having thus plac'd the given Numbers, you are to link or combine the ſeveral Rates of the Simples the one to the other, by certain Arches, in ſuch ſort that one that is leſſer than the Root (or mean Rate) may be linked or coupled to another that is greater than the mean rate, ſo the Queſtion laſt propounded will ſtand

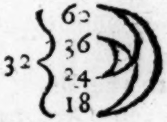
1 *Thus,*



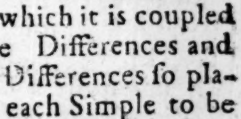
2 *Or thus,*



3 *Or thus,*



4. Then take the Difference between the Root and the ſeveral Branches, and place the Difference of each againſt the Number or Branch with which it is coupled or linked, and having taken all the Differences and placed them as aforeſaid, then thoſe Differences ſo placed will ſhew you the Number of each Simple to be taken to make a Compoſition to bear the mean Rate propounded



So the Branches of the laſt Queſtion being linked together as in the firſt manner, I ſay the Difference between 32 and 60 is 28 which I put againſt 18, becauſe 60 is linked with 18, then the Difference between 32 and 36 is 4, which I put againſt 24 becauſe 36 is linked or coupled with 24, then I ſay, the difference between 32 and 24 is 8, which I place againſt 36 (for the reaſon aforeſaid) then I ſay the difference between 32 and 18 is 14, which I place againſt 60; and then the Work will ſtand as you ſee in the Margent.

So I conclude that a Compoſition made of 14 Buſhels of Wheat at 60 *d. per* Buſhel, and 8 Buſhels of Rye at 36 *d. per* Buſhel, and 4 Buſhels of Barley at 24 *d. per* Buſhel, and 28 Buſhels of Oats at 18 *d. per* Buſhel, will bear the mean price of 32 *d.* or 12 s. 8 *d per* Buſhel. And here obſerve, that in the Compoſition there is but 14 Buſhels of Wheat; but I would mingle 20 Buſhels, and this kind, (or rather caſe) of Alligation Alternate, (*viz.*) when there is given a certain quantity of one of the Simples, and the Quantities of the reſt ſought to mingle with this given Quantity, (that the whole may bear a price propounded) is called Alternation Partial.

And the Proportion to find out the ſeveral Quantities to be mingled with the given Quantity, is as followeth, *viz.*

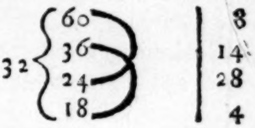
As the difference annexed to the Branch, that is the Value of an Integer of the given Quantity is to the other particular Differences, ſo is the Quantity given to the ſeveral Quantities required

So here to find out how much Rye, Barley, and Oats, muſt be mingled with the 20 Buſhels of Wheat, I ſay, by the *Single Rule of* 3 *Direct*, if 14 Buſhels of Wheat require 8 Buſhels of Rye, what will 20 Buſhels of Wheat require? *Anſwer*, $11\frac{6}{14}$ Buſhels of Rye.

Again if 14 Buſhels of Wheat require 4 Buſhels of Barley, what will 20 Buſhels of Wheat require? *Anſwer*, $5\frac{10}{14}$ Buſhels of Barley. Again I ſay, if 14 Buſhels of Wheat require 28 Buſhels of Oats, what will 20 Buſhels of Wheat require? *Anſwer*, 40 Buſhels of Oats.

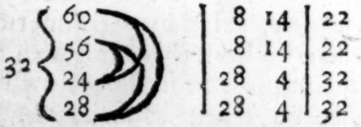
And now I ſay, that 20 Buſhels of Wheat mingled with $11\frac{6}{14}$ Buſhels of Rye, and $5\frac{10}{14}$ Buſhels of Barley, and 40 Buſhels of Oats, each bearing the Rate as aforeſaid, will make a Compoſition or Heap of Corn, that may yield 32 *d. per* Buſhel.

But if the Branches had been coupled according to the ſecond order or manner, the differences would have been thus placed *viz.* the difference between 32 and 60 is 28, which I ſet againſt 24 becauſe 60 is linked thereto; and the difference between 32 and 36 is 4 which I ſet againſt 18, and the difference between 32 and 24 is 8, which I ſet againſt 60; then the difference between 32 and 18 is 14, which I ſet againſt his Yokefellow 36, and then I conclude that if you mix 8 Buſhels of Wheat with 4 Buſhels of Rye, 28 Buſhels of Barley, and 4 Buſhels of Oats, each bearing the aforeſaid Prices, the whole Mixture may be ſold for 32 *d. per* Buſhel, as by the Work in the Margent.



You ſee by this Work we have found how many Buſhels of Rye, Barley and Oats, ought to be mixed with 8 Buſhels of Wheat, and to find out how many of each ought to be mixt with 20 Buſhels of Wheat, I ſay as 8 is to 14, ſo is 20 to 35 Buſhels of Rye. As 8 is to 28, ſo is 20 to 70 Buſhels of Barley. As 8 is to 4 ſo is 20 to 10 Buſhels of Oats, whereby I conclude, that if to 20 Buſhels of Wheat I put 35 Buſhels of Rye, 70 Buſhels of Barley, and 10 Buſhels of Oats, bearing each the aforeſaid price *per* Buſhel, that then a Buſhel of this mixture will be worth 32 *d* or 2 *s.* 8 *d.*

And if the Branches had been linked as you ſee in the third place where each Branch bigger than the Root is linked to two that are leſſer than the Root, then in this Caſe, you muſt have placed the ſeveral differences between the Root and Branches, againſt thoſe two with which each is coupled, as firſt, the difference between 32 and 60 is 28, which I ſet againſt 24 and 18, becauſe it is coupled.



with them both, then the Difference between 32 and 36 is 4, which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to them both, then the difference between 32 and 84 is 8, which I put againſt 60 and 36, becauſe 24 is linked to them both, then the difference between 32 and 18 is 14, which I put againſt 60 and 36, the yoke-fellow of 18.

Laſtly, I draw a Line behind the Differences, and add the Differences which ſtand againſt each Branch, and put the Sum behind the ſaid Line againſt its proper Branch, as you ſee in the Margent.

And now by this Work, I find that 22 Buſhels of Wheat mingled with 22 Buſhels of Rye, and 32 Buſhels of Barley, and 32 Buſhels of Oats, each bearing the ſaid price, will make a Mixture bearing the mean rate of 32 *d. per* Buſhel.

And to find how much of each of the reſt muſt be mingled with 20 Buſhels of Wheat, I ſay,

As 22 is to 22, ſo is 20 to 20 Buſhels of Rye. As 22 is to 32, ſo is 20 to $29\frac{2}{32}$ Buſhels of Barley. As 22 is to 32, ſo is 20 to $29\frac{2}{32}$ Buſhels of Oats.

Whereby you ſee the Queſtions of Alligation Alternate will admit of more true Anſwers than one; for we have found three ſeveral Anſwers to this firſt Queſtion.

Queſtions of Alteration Partial are prov'd the ſame way with Queſtions in Alligation Medial, which you may ſee in the 3d Rule of the 17th Chapter.

The Proof of Alternation Partial.

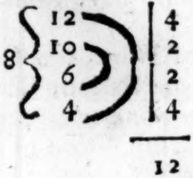
Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz.* of 12 *d. per l* of 10 *d. per l.* of 6 *d. per l.* and of 4 *d. per l* and he would have a Compoſition worth 8 *d. per l.* the whole Quantity whereof ſhould contain 144 *l.* made of theſe 4 ſorts; I demand how much of each he muſt take.

Queſtions of this Nature are reſolved by that part of Alligation Alternate, call'd by Arithmeticians, Alternation Total, *viz.* where there is given the Sum and prices of ſeveral Simples, to find out how much of each Simple ought to be taken to make the ſaid Sum or

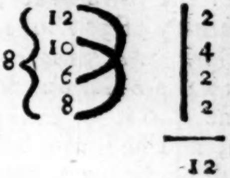
Quantity, ſo that it may bear a certain Rate propounded.

To reſolve this *Queſtion*, I place the ſeveral Prices of the Simples and mean Rate propounded, and link them together, as is directed in the 2d and 3d Rules of this Chapter, and place the differences between the *Root* and *Branches* according to the ſourth Rule of this Chapter, which will then ſtand one of theſe three ways, *viz.*

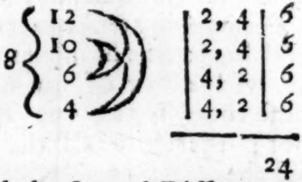
Firſt.



Second.



Third



5. Then add the ſeveral Differences together, which I have done, and the Sums of the firſt and ſecond Order are 12 *l.* and of the third 24 *l.* as you may ſee above. But it is required that there ſhould be 144 *l.* of the Compoſition, therefore to find the Quantity of each Simple to make the whole Compoſition 144 *l.* Obſerve this general Rule, *viz.*

As the Sum of the Differences is to the ſeveral Differences, ſo is the total Quantity of the Compoſition to the Quantity of each Simple.

So to find how much of each ſort of Sugar I ought to take to make 144 *l.* at 8 *d. per l.* I ſay,

As 12 is to 4, ſo is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 6 *d. per l.*
As 12 is to 4, ſo is 144 to 48 *l.* at 4 *d. per l.*

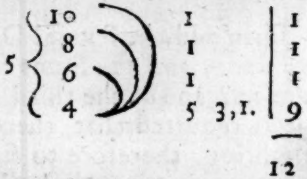
Whereby I find that 48 *l.* at 12 *d. per l.* and 24 *l.* at 10 *d. per l.* and 24 *l* at 6 *d. per l* and 48 *l* at 4 *d. per l.* will make a Compoſition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the Branches are link'd in the ſecond order, the Anſwer will be 24 *l* at 12 *d per l.* and 48 *l.* at 10 *d. per l.* and 48 *l* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the ſaid quantity, and to bear the ſaid price.

And if you had worked as the Branches are linked after the third order, then you would have found the quantity of 36 *l.* of each.

Queſt. 3. A Vintner hath 4 ſorts of Wine, *viz* Canary at 10 *s. per* Gallon, Malaga at 8 *s. per* Gallon, Rheniſh wine at 6 *s. per* Gallon, and White-wine at 4 *s per* Gallon, and he is minded to make a Compoſition of them all of 60 Gallons, that may be worth 5 *s. per* Gallon, I deſire to know how much of each he muſt have?

The Number of Terms being ranked according to the ſecond Rule of this Chapter, the Branches will be link'd as followeth, but will admit of no other manner of coupling, becauſe there is but one Branch that is leſſer than the Root; therefore all the reſt muſt be linked unto it; and the differences between the Root and the three firſt Branches, *viz.* 10, 8, and 6, which are 5, 3, and 1 muſt be ſet againſt 4 becauſe they are coupled with it, and the difference between the Root (*viz.*) 5 and 4 which is 1. muſt be ſet againſt the 3 other, becauſe it is linked to them all; ſo I find 1 Gallon of Canary, 1 Gallon of Malaga, 1 Gallon of Rheniſh-wine, and 9 Gallons of White-wine, prized as above, being mingled together, will be worth 5 *s per* Gallon, the Sum being 12 Gallons, but there muſt be 60 Gallons; wherefore I ſay,



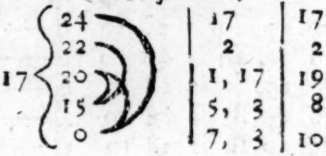
As 12 is to 1, ſo is 60 to 5 Gallons of Canary.
As 12 is to 1, ſo is 60 to 5 Gallons of Malaga.
As 12 is to 1, ſo is 60 to 5 Gallons of Rheniſh.
As 12 is to 9, ſo is 60 to 45 Gal. of White-wine,

ſo that 5 Gallons of Canary, 5 Gallons of Malaga, 5 Gallons of Rheniſh, and 45 Gallons of White-wine mingled together, will be in all 60 Gallons, worth 5 *s.* *per* Gallon, which was required.

Queſt. 4 A Goldſmith hath Gold of 4 ſeveral ſorts of fineneſs, *viz.* of 24 Carects fine. and of 22 Carects fine, of 20 Carects fine, and of 15 Carects fine. And he would mingle ſo much of each with Alloy, that the whole maſs of 28 Ounces of Gold ſo mingled, may bear 17 Carects fine. I demand how much of each he muſt take? the ſecond and third Rules of this Chapter being obſerved; (or inſtead of the alloy I put 0, becauſe it bears no fineneſs, but it makes a Branch in the Operation) the terms may be alligated, and the differences added by any of theſe 4 ways following, *viz.*

Read Chap. 2. Def. 3. of this Book.

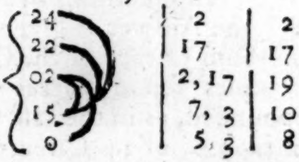
Firſt thus,



17	24	17	17
	22	2	2
	20	1, 17	19
	15	5, 3	8
	0	7, 3	10

Sum 56

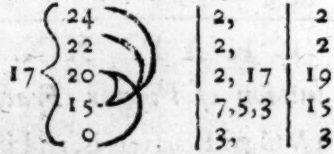
Secondly thus,



24	2	2
22	17	17
02	2, 17	19
15	7, 3	10
0	5, 3	8

Sum 56

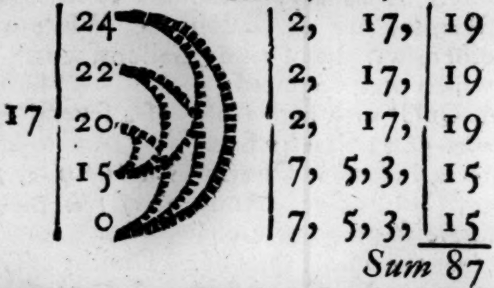
Thirdly thus,



17	24	2,	2
	22	2,	2
	20	2, 17	19
	15	7, 5, 3	15
	0	3,	3

Sum 41

Fourthly thus,



	24	2, 17,	19
	22	2, 17,	19
17	20	2, 17,	19
	15	7, 5, 3,	15
	0	7, 5, 3,	15
		Sum	87

More ways may be given for the Alligating or linking of the Terms in this Queſtion. but theſe are ſufficient for the Induſtrious And it ſhall alſo ſuffice to give an Anſwer to the Queſtion as the Terms are link'd the firſt Way, not doubting but the ingenious Practitioner will be able at his leiſure to find Anſwers to the other 3 ways, *viz.*

	oz.	*p. w.*	*Car.*
As 56 is to 17, ſo is 28 to	8	10	of 24
As 56 is to 2, ſo is 28 to	10	00	of 22
As 56 is to 19, ſo is 28 to	9	10	of 20
As 56 is to 18 ſo is 28 to	4	00	of 15
As 56 is to 10 ſo is 28 to	5	00	of alloy

Thus much well practiſed and underſtood, is ſufficient for underſtanding Alligation.

The Proof of Alternation Total.

In Queſtions of Alternation Total, the Anſwer is given true when the Sum of each of the Quantities of Simples found, agrees with the Sum or Quantity propounded, as in the laſt Queſtion the Anſwer was 8 *oz.* 10 *p.w.* of 24 Carects fine, 10 *oz* of 22 Carects fine, 9 *oz.* 10 *p.w* of 20 Carects fine. 4 of 15 Carects fine, and 5 *oz* of Alloy, which added together makes 28 *oz.* the Quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1 WHat a Vulgar Fraction is, and its parts and ſeveral Kinds, hath been already ſhewed in

the 19, 20, 21, 22, 23, 24 and 31 Definitions of the firſt Chapter of this Book, which the Learner is deſired diligently to obſerve before he proceeds.

2. To reduce a Vulgar Fraction (which diſcovereth the principal knowledge of Fractions, and therefore ought greatly to be regarded) we ſhall diſcover plainly under theſe eight ſeveral Heads (or Rules) following *viz.*

2. To reduce a mixt Number into an improper Fraction.

1. To reduce a whole Number into an improper Fraction.

3. To reduce an improper Fraction into its equivalent whole, or mixt Number.

4. To reduce a Fraction into the loweſt Terms equivalent to the Fraction given.

5. To find the Value of a Fraction in the known parts of Coyn, Weight, Meaſure, *&c.*

6. To reduce a Compound Fraction to a Simple one of the ſame Value.

7. To reduce divers Fractions having unequal Denominators, to Fractions of the ſame value, having an equal Denominator.

8. To reduce a Fraction of one Denomination to another of the ſame Value.

1. To reduce a mixt Nnmber to an improper Fraction.

The Rule is, *Vide Chap.* 1. *defin.* 31.

Multiply the Integer Part (or whole Number) by the Denominator of the Fraction, and to the Product add the Numerator, and that Sum Place over the Denominator for a new Numerator, ſo this new Fraction ſhall be equal to the next Number given. As for Example.

1. Reduce $18\frac{3}{7}$ into an improper Fraction, multiply the whole Number 18 by 7 the Denominator, and to the Product add the Numerator 3, the Sum is 129, which put over the Denominator 7, and it makes $\frac{129}{7}$, for the Anſwer as followeth.

$18\frac{3}{7}$

$$\begin{array}{r} 18\frac{3}{7} \\ 7 \\ \hline 129 \end{array}$$

facit. $\frac{129}{7}$

2. Reduce $183\frac{5}{21}$ to an improper Fraction, *facit.* $\frac{2201}{21}$.
3. Reduce $50\frac{13}{21}$ to an improper Fraction, *facit.* $\frac{1189}{21}$.

II. *To reduce a whole Number into an improper Fraction.*

The Rule is,

Multiply the given Number by the intended Denominator, and place the Product for the Numerator over it. As for Example.

Vide Chap. 1. *Defin.* 23.

1. Let it be required to reduce 15 into a Fraction, whoſe Denominator ſhall be 12. To effect which I multiply 15 by the intended Denominator (12) the Product is 180, which I place over 12 as a Numerator, and it makes $\frac{180}{12}$ which is equal to 15 as was required; as *per* Margent.

facit. $\frac{180}{12}$

$$\begin{array}{r} 15 \\ 12 \\ \hline 30 \\ 15 \\ \hline 180 \end{array}$$

2. Reduce 36 into an improper Fraction, whoſe Denominator ſhall be 26, *facit* $\frac{936}{26}$.

3. Reduce 135 into an improper Fraction, whoſe Denominator ſhall be 16, *facit* $\frac{2160}{16}$.

III. *To reduce an improper Fraction into its equivalent whole or mixt Number.*

The Rule is,

Divide the *Numerator* by the *Denominator*, and the Quotient is the whole Number equal to the Fraction, and if any thing remain, put it for a Numerator over the Diviſor.

1. Reduce $\frac{436}{8}$ into its equivalent mixt Number. Divide the Numerator 436 by the Denominator 8, and the Qotient is 54, and 4 remains, which put for a Numerator over the Diviſor 8, the Anſwer is $54\frac{4}{8}$, as followeth,

```
8) 436 (54
   40
   ---
    36 Fac't 54 4/8
    32
   ---
    (4)
```

2. Reduce $\frac{1476}{15}$ to a mixt Number, *facit*, $231\frac{11}{15}$.

3. Reduce $\frac{25576}{136}$ to a mixt Number, *facit*, $114\frac{72}{136}$.

IV. *To reduce a Fraction into its loweſt Terms equivalent to the Fraction given.*

The Rule is,

1. If the Numerator and Denominator are even Numbers, take half the one and half of the other as often as may be, and when either of them falls out to be an odd Number, then divide them by any Number that you can diſcover will divide both Numerator and Denominator without any Remainder; and when you have thus proceeded as low as you can reduce them, then this new Fraction ſo found out, ſhall be the Fraction you deſire, and will be in Value equal to the given Fraction.

Example.

1. Let it be required to reduce $\frac{192}{336}$ into its loweſt Terms. Firſt I take the half of the Numerator 192, and it is 96, then half of the Denominator, and it is 168, ſo that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing ſtill, to $\frac{24}{42}$ and their half is $\frac{12}{21}$, and now I can no longer half it becauſe 21 is an odd Number, wherefore I try to divide them by 3, 4, 5, 6, &c. and I find 3 divides them both without any Remainder, and brings them to $\frac{4}{7}$, as *per* Margent.

192	96	48	24	12	4
336	168	84	42	21	7

So I conclude $\frac{4}{7}$ thus found, to be equal in Value to the given Fractions $\frac{192}{336}$.

2. What is $\frac{1036}{1184}$ in its loweſt Terms? *Anſwer*, $\frac{7}{8}$.

3. What is $\frac{1342}{1586}$ in its loweſt Terms? *Anſwer*, $\frac{11}{13}$.

There is yet another Way more excellent than the former, to reduce a Fraction into its loweſt Terms, and that is by finding a common Meaſure, *viz.* the greateſt Number that will divide the Numerator and Denominator without any Remainder, and by that Means reduce a Fraction to its loweſt Terms at the firſt Work; and to find out this common Meaſure, divide the Denominator by the Numerator, and if any thing remains, divide your Diviſor thereby; and if any thing yet remain, then divide your laſt Diviſor by it; do ſo until you find nothing remaining; then this laſt Diviſor ſhall be the greateſt common Meaſurer, which will divide both Numerator and Denominator, and reduce them both into their loweſt Terms at one Work.

Vid. *Ought. Cla. Matth.* cap. 7.

Example,

4. Reduce $\frac{228}{304}$ into its loweſt Terms by a common Meaſurer; to effect which, I divide the Denominator 304 by the Numerator 228, and there remains 76, then I divide 228 (the firſt Diviſor) by 76 (the Remainder) and it quotes 3, and nothing remains; wherefore the laſt Diviſor is the common Meaſurer; by which I divide the Numerator of the given Fraction *viz.* 228, it quotes 3 for a new Numerator, then I divide the Denominator 304 by 76, and it quotes 4 for a new Denominator, ſo that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its loweſt Terms by a common Meaſurer, *Facit*, $\frac{9}{12}$.

6. Reduce $\frac{3081}{20382}$ into its loweſt Terms by a common Meaſurer, *Facit*, $\frac{13}{86}$.

A Compendium.

Note, That if the Numerator and Denominator of a Fraction, end each with a Cypher or Cyphers, then cut off as many Cyphers from the one as from the other, and the remaining Figures will be a Fraction of the ſame Value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{34}{71}$, by cutting off the two Cyphers from the Numerator and Denominator with a daſh of the Pen thus, $\frac{34}{71}|\frac{00}{00}$, and $\frac{4600}{7000}$, will be $\frac{46}{70}$, thus $\frac{46}{70},\frac{0}{0}$, *&c.*

V. *To find the Value of a Fraction in the known Parts of Coyn, Weights,* &c.

The Rule, is,

Multiply the Numerator by the Parts of the next inferior Denomination that are equal to an Unit of the ſame Denomination with the Fraction; then divide that Product by the Denominator, and the Quote gives you its Value in the ſame Parts you multiply'd by, and if any Thing remain, multiply it by the Parts of the next inferior Denomination, and divide as before; do ſo, till you can bring it no lower, and the ſeveral Quotients will give you the Value of the Fraction as was requir'd; and if any Thing at laſt remain, place it for a Numerator over the former Denominator. Some new Examples will make the Rule plain.

1. What is the Value of $\frac{27}{29}$ *l. Sterling*? To anſwer this Queſtion, I multiply the Numerator 27 by 20, (the Shillings in a Pound) the Product is 540, which I divide by 29 (the Denominator) and the Quotient is 18 *s.* and there remains 18, which I multiply by 12 Pence, and the product (216) I divide by the Denominator 29, the Quotient is 7 *d* and 13 remains, which I multiply by 4 Farthings, the product is 52, which I ſtill divide by 29, the Quotient is 1 Farthing, and there remaineth 23, which I put for a Numerator, over the Denominator 29, ſo I find the Value of $\frac{27}{29}$ *l.* to be 18 *s.* 7 *d.* 1 *qr.* $\frac{23}{29}$, as by the following Operation; and after the ſame Manner are the Values of the Fractions in the ſeveral Examples following found out.

$\frac{27}{29}$ *l.*

$\frac{27}{19}$ *l.*
27
Multiply 20
qrs.
29) 540 (18*s*.7*d*.1$\frac{23}{29}$
. .
29

250
232

Remains (18)
Multiply 12

36
18

29) 216 (7 *d.*
243

Remains (13)
Multiply 4
qr.
29) 52 (1$\frac{23}{29}$
29

Remains (23)
s. *d.* *qr.*
Facit 18—7—1$\frac{23}{29}$.

2. What is the value of $\frac{11}{15}$ *l Sterling?* *Facit* 14 *s.* 8 *d.*

3. What is the value of $\frac{28}{137}$ *l. Sterling?* *Facit,* 4 *s.* 1 *d.* $\frac{7}{137}$.

4. What is $\frac{16}{21}$ C, weight? *Facit* 3 *qrs.* 1 *l.* 5 *oz* $\frac{7}{21}$.

5. What is $\frac{136}{371}$ *l. Troy-weight?* *Fecit,* 4 *oz.* 7 *p. w.* 23 *gr.* $\frac{179}{371}$.

6. What is $\frac{41}{50}$ of a Year? *Aaſwer,* 299 *days,* 7 *hours.* 12. *min.*

V. *To reduce a Compound Fraction to a ſimple One of the ſame Value.*

What a Compound Fraction is, hath been ſhewn in Chap. 1. Definition 24. and to reduce it to a Simple Fraction of the ſame Value,

The Rule is,

Multiply the Numerators continually, and place the laſt Product for a new Numerator, then multiply the Denominators continually, and place the laſt Product for a new Denominator. So this ſingle Fraction ſhall be equal to the Compound Fraction. *Example.*

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a Simple Fraction.

Multiply the Numerators 2, 3, and 5 together, they make 30 for a new Numerator; then I multiply the Denominators 3, 5 and 8 together, and their Product is 120 for a Denominator, ſo the Simple Fraction is $\frac{30}{120}$, and cutting off the Cyphers, it is $\frac{3}{12}$, equal to $\frac{1}{4}$ by the Fourth Rule foregoing.

$$\begin{array}{r}5\\3\\\hline 15\\8\\\hline 120\end{array}\qquad\qquad\begin{array}{r}2\\3\\\hline 6\\5\\\hline 30\end{array}$$

Facit $\frac{32}{120}$ or $\frac{3}{12}$ or $\frac{1}{4}$.

What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? *Anſwer*, $\frac{1540}{7560}$ or $\frac{154}{756}$, or $\frac{77}{378}$ in its leaſt Terms.

4. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? *Anſwer*, $\frac{3003}{4872}$.

By this you may know how to find the Value of a Compound Fraction, *viz.* Firſt reduce it to a Simple one, and then find out his Value by the 5th Rule foregoing.

Example.

4. What is the Value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{12}$ of a *Pound*? *Anſwer*, 11 *s.* 3 *d.*

VII. *To reduce Fractions of unequal Denominators, to Fractions of the ſame Value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product ſhall be the Common Denominator. Then multiply each Numerator into all the Denominators, except its own, and the laſt Product put for a Numerator over the Denominator, found out as before: So this new Fraction is equal to that Fraction, whoſe Numerator you multiply'd into the ſaid Denominators. Do ſo by all the Numerators given, and you have your Deſire.

Example,

1. Reduce $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$ and $\frac{7}{8}$ to a Common Denominator. Multiply the Denominators 4, 5, 6, and 8 together continually, and put the Products 960 for the *Common* Denominator; then multiply the Numerator 3 into the Denominators 5, 6, and 8, and the Product is 720, which is a Numerator to 960 (found as before) ſo $\frac{720}{960}$ is equal to the firſt Fraction $\frac{3}{4}$; then I proceed to find a new Numerator to the ſecond Fraction, *viz* $\frac{4}{5}$, and I multiply 4 (into all the Denominators except its own, *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the Numerator 5 into the Denominators 4, 5, and 8, the Product is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the Numeraror 7 into the Denominators 4, 5, and 6, the Product is $\frac{840}{960}$ equal to $\frac{7}{8}$ and the Work is done; ſo that for $\frac{3}{4}$ $\frac{4}{5}$ $\frac{5}{6}$ and $\frac{7}{8}$ I have $\frac{720}{960}$ $\frac{768}{960}$ $\frac{800}{960}$, and $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$ $\frac{54}{23}$, and $\frac{19}{21}$ into a common Denominator, *faciunt* $\frac{2313}{5796}$, $\frac{3525}{5796}$ and $\frac{5244}{5796}$.

VIII. *To*

VIII. *To reduce a Fraction of one Denomination to another.*

1. This is either Aſcending or Deſcending. Aſcending, when a Fraction of a ſmaller is brought to a greater Denomination; Deſcending, when a Fraction of a greater Denomination is brought lower.

2. When a Fraction is to be brought from a leſſer to a greater Denomination, then make of it a Compound Fraction, by comparing it with the intermediate Denominations between it and that you would have it reduced to, then (by the 6th Rule foregoing) reduce your Compound to a Single Fraction, and the Work is done. *Example.*

Queſt. 1. It is required to know what part of a Pound *Sterling* $\frac{5}{7}$ of a Penny is?

To reſolve this, I conſider that 1 *d.* is $\frac{1}{12}$ of a Shilling, and a Shilling is $\frac{1}{20}$ of a Pound; wherefore $\frac{5}{7}$ *d.* is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a Pound, which by the ſaid 6th Rule I find to be $\frac{5}{1680}$ of a Pound *Sterling* of *Engliſh* Money.

Queſt. 2. What part of a Pound *Troy-weight* is $\frac{4}{5}$ of a *Penny-weight*? *Anſwer,* $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{1}{1200}$ *l. Troy.*

3. When a Fraction is to be brought from a greater to a leſſer Denomination, then multiply the Numerator by the parts contain'd in the ſeveral Denominations betwixt it and the parts you would reduce it to; then place the laſt Product over the Denominator of the given Fraction. *Example,*

Queſt. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a *Penny*; to do which, I multiply the Numerator 3 by 20 and 12, the Product is 720, which I put over the Denominator 5, it makes $\frac{720}{5}$ of a *Penny*, equal to $\frac{3}{5}$ *l.*

Queſt. 7. What parts of an Ounce *Troy* is $\frac{5}{18}$? *Anſwer,* $\frac{60}{18}$ *oz.*

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common Denominator, then add all the Numerators together, and place their Sum for a Numerator to the common Denominator, which new Fraction is the Sum of all the given Fractions; and if it be improper, reduce it to a whole or mixt Number, by the 3d Rule of the 29th Chapter.

Queſt. 1. What is the Sum or $\frac{7}{24}$ $\frac{9}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz.* ever one is 24, wherefore add the Numerators together, *viz.* 7, 9, 16, and 14, their Sum is 46, which put over the Denominator 24, it makes $\frac{46}{24}$ the Sum of the given Fractions, which will be reduced to the mixt Numbers $1\frac{22}{24}$, or $1\frac{11}{12}$.

2. But if the Fractions to be added have unequal Denominators, then reduce them to a common Denominator by the 7th Rule of the 19th Chapter, and then add the Numerators together, and put the Sum over the common Denominator, &c. as before in the laſt Example.

Queſt. 2. What is the Sum of $\frac{3}{5}$, $\frac{7}{8}$, $\frac{9}{10}$, and $\frac{11}{12}$?

The Fractions reduced to a common Denominator are $\frac{2880}{4800}$, $\frac{4300}{4800}$, $\frac{4320}{4800}$, and $\frac{4400}{4800}$. the Sum of their Numerators is 15800 which put over the common Denominator, makes $\frac{15800}{4800}$, or $\frac{158}{48}$ equal to the mixt Number $3\frac{14}{48}$, or $3\frac{7}{24}$ for the Sum required.

Queſt. 3. What is the Sum of $\frac{13}{17}$, $\frac{21}{47}$, and $\frac{39}{47}$? *Anſwer*, $1\frac{37555}{39151}$.

3. If you are to add mixt Numbers together, then add the Fractional Parts as before, and if their Sum be an improper Fraction, reduce it to a mixt Number, and add its integral Part to the integral Parts of the given mixt Numbers, and the Work is done.

Queſt. 4. What is the Sum of $13\frac{3}{4}$ and $24\frac{5}{8}$?

Firſt add the Fractions $\frac{3}{4}$ and $\frac{5}{6}$ the Sum is $1\frac{12}{32}$, then add this Integer 1, to 13 and 24, their Sum is 38 and put after it the Fraction $\frac{12}{32}$ it is 38 $\frac{12}{32}$ for the Anſwer; or it is $38\frac{3}{8}$.

Queſt. 5. What is the Sum of 48 $\frac{3}{7}$, 64 $\frac{5}{8}$ and 130 $\frac{3}{4}$?
Facit, 243 $\frac{180}{224}$, or 243 $\frac{45}{56}$.

4. If any of the Fractions to be added, is a Compound Fraction, it muſt firſt be reduced to a Simple Fraction by the 6th Rule of Chapter 19, and then add it to the reſt, according to the 2d Rule of this Chapter. *Example.*

Queſt. 6. What is the Sum $\frac{3}{4}$ $\frac{5}{6}$, and $\frac{7}{8}$ of $\frac{5}{4}$ of $\frac{5}{6}$?

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a Simple Fraction, and it is $\frac{105}{192}$ which reduced with the other two, and added, are $1\frac{4686}{5760}$.

Queſt. 7. What is the Sum of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$?
Anſwer, $1\frac{5}{12}$.

5. If the Fractions to be added are not of one Denomination, they muſt be ſo reduced, and then proceed as before.

Queſt, 8. What is the Sum of $\frac{3}{4}$ and $\frac{5}{6}$ *s.*?

Of the given Fractions here, one is of a Pound, and the other the Fraction of a Shilling, and before you can add them together, you muſt reduce $\frac{5}{6}$ *s.* to the Fraction of a Pouud as the other is (by the 8th Rule of Chapter 19) and it makes $\frac{5}{12}$. *l.* then $\frac{3}{4}$ and $\frac{5}{120}$ *l.* will be found to be $\frac{380}{480}$ *l.* or $\frac{38}{48}$ *l.* by the 7th Rule of Chapter 19, and in its loweſt Terms $\frac{19}{24}$ *l.* by the 4th Rule of Chapter 19.

It would have been the ſame if (by the latter part of the 8th Rule of Chapter 19.) you had reduc'd $\frac{3}{4}$ *l.* to the Fraction of a Shilling; which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the ſaid 17th Rule of the laſt Chapter, the Sum is 15 *l.* $\frac{20}{24}$ which is equal to the Sum found, as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5th Rule of Chapter 19.) the value of $\frac{19}{24}$ *l.* will be found to be 15 *s.* 10 *d.* and ſo will 15 *s.* $\frac{20}{24}$ be found to be juſt as much.

Queſt. 9. What is the Sum of $\frac{3}{5}$ *l.* $\frac{3}{5}$ *s* $\frac{3}{5}$ *d.*? *Anſwer*, $\frac{379500}{600000}$ or $\frac{3795}{6000}$ or in its loweſt Terms $\frac{253}{400}$.

CHAP. XXI.

Subtraction of Vulgar Fractions.

1. THE Rules in Addition for reducing the given Fractions to one Denomination, are here to be obſerved; for before Subtraction can be made, the Fractions muſt be reduc'd to a common Denominator, then ſubtract one Numerator from the other, and place the Remainder over the common Denominator, which Fraction ſhall be the Exceſs or Difference between the given Fraction, *Examples.*

Queſt. 1. What is the Difference between $\frac{3}{4}$ and $\frac{5}{7}$? The given Fractions are reduc'd to $\frac{21}{28}$ and $\frac{20}{28}$, then ſubtract the Numerator 20 from the Numerator 21, and there remains 1, which being put over the Denominator 28, makes $\frac{1}{28}$ for the Anſwer or Difference between $\frac{3}{4}$ and $\frac{5}{7}$.

Queſt. 2. What is the Difference between $\frac{5}{6}$ and $\frac{3}{5}$ of $\frac{5}{8}$? Reduce the Compound Fraction $\frac{3}{4}$ of $\frac{5}{8}$ to a Simple Fraction, then proceed as before, and the Anſwer is $\frac{110}{240}$ equal to $\frac{10}{24}$.

2. When a Fraction is given to be ſubtracted from a Whole Number, ſubtract the Numerator from the Denominator, and put the Remainder for a Numerator to the given Denominator, and ſubtract an Unit (for that you borrow'd) from the Whole Number, and the Remainder place before the Fraction found, as before, which mix'd Number is the Remainder or Difference ſought. *Example.*

Queſt. 3. Subtract $\frac{7}{10}$ from 48.

Anſwer, 47 $\frac{3}{10}$; for if you ſubtract 7 (the Numerator) from 10 (the Denominator) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrow'd) from 48 reſts 47, to which joyn $\frac{3}{10}$, and it makes 47 $\frac{3}{10}$ for the Exceſs.

Queſt. 4. Subtract $\frac{13}{21}$ from 57, remains 56 $\frac{8}{21}$.

3. If it be requir'd to ſubtract a Fraction from a mixt Number, or one mixt number from another, reduce the Fractions to a Common Denominator, and if the Fraction to be ſubtracted be leſſer than the other, then ſubtract the leſſer Numerator from the greater, and that is a Numerator for the common Denominator, then ſubtract the leſſer integral part from the greater, and the Remainder with the remaining Fraction thereto annexed is the Difference requir'd between the two given mixt Numbers. *Example.*

Queſt. 5. Subtract 26 $\frac{3}{7}$ from 54$\frac{5}{6}$.

Firſt, Subtract $\frac{3}{7}$, *viz.* $\frac{18}{42}$ from $\frac{5}{6}$ *viz.* $\frac{35}{42}$, the Remainder is $\frac{17}{42}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{42}$ it makes 28$\frac{17}{42}$ for the Anſwer.

4. But if the Fraction to be ſubtracted is greater than the Fraction from whence you ſubtract, then having firſt reduced the Fractions to a Common Denominator, take the Numerator of the greateſt Fraction out of the Denominator, and add the Remainder to the Numerator of the leſſer Fraction, and their Sum is a new Numerator to the Common Denominator, which Fraction note, then (for the 1 you borrow'd) add 1 to the Integral part to be ſubtracted, and ſubtract it from the greater *Number*, and to the Remainder annex the Fraction you noted before, ſo this new mixt *Number* ſhall be the Difference ſought. *Example.*

Queſt 6, Subtract 14$\frac{3}{4}$ from 29 $\frac{4}{7}$.

The Fractions reduc'd are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I ſhould ſubtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I ſubtract 21 from 28, reſts 7, which added to 16 (the leſſer Numerator) makes 23 for a Numerator to 28, *viz.* $\frac{23}{28}$; then I come to the Integral parts 14 and 29, and ſay, 1 that I borrow'd and 14 is 15, which taken from 29 there reſts 14, to which annexing $\frac{23}{28}$ it is 14 $\frac{23}{28}$ for the Remainder or Difference between 14$\frac{3}{4}$ and 29$\frac{4}{7}$.

Queſt. 7. Subtract 36 $\frac{9}{10}$ from 74 $\frac{4}{9}$ *facit*, 37$\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. IF the Multiplicand and Multiplier are Simple (or Single) Fractions, then multiply the Numerators together for a new Numerator, and the Denominators for a new Denominator, and the new Fraction is the Product required.

Queſt. 1. What is the Product of $\frac{5}{7}$ by $\frac{9}{11}$? *Facit*, $\frac{45}{77}$, for the Numerators 5 and 9 being multiply'd, make 45, and the Denominators 7 and 11, being multiply'd, make 77.

Queſt 2. What is the Product of $\frac{18}{23}$ by $\frac{21}{37}$? *facit*, $\frac{378}{851}$.

2. If the Fractions to be multiply'd are mixt Numbers, reduce them to Improper Fractions by the 1ſt Rule of the 19th Chapter, then proceed as before.

Queſt. 3. What is the Product of 28 $\frac{3}{5}$ by 13 $\frac{5}{6}$?

The given mixt Numbers being reduc'd to Improper Fractions are 48 $\frac{3}{5}$ equal to $\frac{243}{5}$, and 13 $\frac{5}{6}$ equal to $\frac{83}{6}$, now $\frac{243}{5}$ multiply'd by $\frac{83}{6}$, according to the 1ſt Rule of this Chapter, produceth $\frac{2919}{306}$ or 672 $\frac{9}{80}$.

Queſt. 4. What is the Product of 430 $\frac{6}{10}$ by 18 $\frac{3}{7}$? *Facit*, $\frac{555474}{70}$ or 7635 $\frac{24}{70}$.

3. If a Compound Fraction is to be multiply'd by a Simple Fraction, firſt reduce the Componnd Fraction into a Simple Fraction, then multiply the one by the other, as is taught above.

Queſt. 5. What is the Product of $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$? The Compound Fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduc'd is $\frac{80}{140}$. or $\frac{6}{14}$ which multiply'd by $\frac{16}{21}$ produceth $\frac{96}{294}$ which in its loweſt Term is $\frac{16}{49}$ for the *Anſwer*.

And if the Multiplicand and Multiplier are both Compound Fractions, reduce them both to Simple ones, then multiply theſe new Fractions as before, ſo have you the Product.

Queſt. 6. What is the Product of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{1}{2}$? *Anſwer*, $\frac{18}{120}$ in its loweſt Terms $\frac{3}{20}$.

Queſt 7. What is the Product of $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{2}{3}$ of $\frac{5}{8}$?

Anſwer, $\frac{60}{360}$ or $\frac{6}{36}$, or in its leaſt Terms $\frac{1}{6}$.

4. If a Fraction be to be multiply'd by a Whole Number; put under the given Whole Number an Unit for a Denominator, whereby it will be an Improper Fraction, then multiply theſe Fractions as before. *Example.*

Queſt. 8. What is the Product of 24 by $\frac{2}{3}$?

Anſwer, $\frac{48}{3}$ for 24 by putting an Unit under it will be $\frac{24}{1}$, and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Queſt. 9. What is the Product of 36 by $\frac{9}{11}$? *Anſwer* $\frac{324}{11}$ or $29\frac{5}{11}$.

CHAP. XXIII.

Diviſion of Vulgar Fractions.

1. IF the Dividend and the Diviſor are both Simple Fractions, then multiply the Numerator of the Dividend into the Denominator of the Diviſor, and the product is a new Numerator, and multiply the Denominator of the Dividend into the Numerator of the Diviſor, and the product is a new Denominator, which new Fraction thus found, is the Quotient you deſire. ***Example.***

Queſt. 1. What is the Quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$?

Anſwer, $\frac{25}{24}$ or $1\frac{1}{24}$, for firſt I multiply (5) the Numerator of the Dividend into (5) the Denominator of the Diviſor, and the product (25) is a Numerator for the Quotient, then multiply (8) the Denominator of the Dividend into (3) the Numerator of the Diviſor, and the product (24) I put in the Quotient for a Denominator, ſo I find $\frac{25}{24}$ is the Quotient ſought.

$$\frac{3}{5}\Big)\frac{5}{8}\Big(\frac{25}{24}$$

Queſt. 2. What is the Quotient of $\frac{10}{21}$ divided by $\frac{2}{3}$?

Anſwer, $\frac{30}{42}$ equal to $\frac{5}{7}$ in its loweſt terms.

2. But if you would divide a Simple Fraction by a Compound, or a Compound by a Simple, firſt reduce

ſuch Compound to a Simple Fraction, then go on as before.

Queſt. 3. What is the Quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$?
Anſwer, $\frac{36}{60}$ or $\frac{3}{5}$, firſt reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a ſimple Fraction and it is $\frac{6}{12}$, by which $\frac{3}{10}$ being divided the Quotient is $\frac{36}{60}$ equal in its leaſt Terms to $\frac{3}{5}$, and if the Devidend and Deviſor be both Compound Fractions, reduce them both to a ſimple Fraction, then divide the one by the other, as in Rule 1 foregoing.

Queſt. 4. What is the Quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{1}{4}$ of $\frac{5}{6}$?
Anſwer, $\frac{180}{120}$ or $\frac{18}{12}$ or 1 $\frac{6}{12}$ or 1 $\frac{1}{2}$ in its loweſt terms.

3. If the Dividend, or Diviſor, or both are mixt Numbers reduce them to improper Fractions, and perform Diviſion as you were taught before.

Queſt. 5. What is the Quote of 12 $\frac{3}{4}$ divided by 21 $\frac{4}{5}$?
Anſwer $\frac{255}{436}$, for 12 $\frac{3}{4}$ is equal to $\frac{51}{4}$ and 21 $\frac{4}{5}$ is equal to $\frac{109}{5}$, and the Quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before, $\frac{255}{436}$.

4. If you divide a Fraction by a whole Number, or a whole Number by a Fraction, make the whole Number an improper Fraction, by putting an Unit for a Denominator to it as was taught in Rule 4 of Chapter 22, and then perform Diviſion as was before taught, Example;

Queſt. 6. What is the Quote of 8 divided by $\frac{3}{5}$?
Anſwer, $\frac{40}{3}$ which is equal to 13$\frac{1}{3}$, being reduced as is before directed. See the Work in the Margent.

$$\frac{3}{5}\Big)\frac{8}{1}\Big(\frac{40}{3}\ \textit{or}\ 13\tfrac{1}{3}.$$

Queſt. 7. What is the Quotient of $\frac{3}{5}$ divided by 8?
Anſwer, $\frac{3}{40}$, as *per* Margent.

$$\frac{8}{1}\Big)\frac{3}{5}\Big(\frac{3}{40}$$

CHAP.

CHAP. XXIV.

The Rule of Three Direct in Vulgar Fractions.

1. AS in the Rule of Three in Whole Numbers, ſo likewiſe in Fractions, you muſt ſee that the Fractions of the firſt and third places be of the ſame Denomination.

2. See that if any of the given Fractions be Compound, that they be reduced to Simple of the ſame Value.

3. If there are given mix'd Numbers, reduce them to improper Fractions by the 1ſt Rule of Chap. 19.

4. If any of the three Terms is a Whole Number, make it an improper Fraction by conſtituting an Unit for its Denominator.

Having reduced your Fraction as is directed in the four laſt Rules, then proceed to a Reſolution, which is performed the ſame way as in Whole Numbers, reſpect being had to the Rules deliver'd for the working of Fractions *viz.* Multiply the 2d and 3d Fractions together, according to the 1ſt Rule of Ch. 22. and divide the Product by the 1ſt Fraction, according to the 1ſt Rule of Chap. 23. and the Quotient is the Anſwer.

Or (which is better)

5. Multiply the Numerator of the firſt Fraction into the Denominator of the ſecond and third, and the Product is a new Denominator, then multiply the Denominator of the 1ſt Fraction into the Numerator of the ſecond and third, and the Product is a new Numerator, which new Fraction is the 4th Proportional or Anſwer, which (if it be an Improper Fraction) muſt be reduced to a whole or mix'd Number by the 3d Rule of Chap. 19. *Examples.*

Queſt. 1. If $\frac{3}{4}$ Yards of Cloth coſt $\frac{5}{8}$ *l.* what will $\frac{6}{80}$ Yards coſt?

Having placed the given Fractions according to the 6th Rule of Chap. 10. I proceed to the Reſolution, and firſt I multiply the Numerator of the 1ſt Fraction (3)

$$\begin{array}{cccc} \textit{yards} & l. & \textit{yards} & l. \\ \frac{3}{4} & \frac{5}{8} & \frac{9}{10} & \frac{180}{240} \end{array}$$

$$\textit{Facit}, \ \overset{l.}{\frac{180}{240}} \ \text{equal to} \ \frac{3}{4}$$

into 8 and 10, the Denominators of the ſecond and third *Fractions*, and the Product is 240 for a Denominator, then I multiply 4 the Denominator of the firſt *Fraction* into 5 and 9, the Numerators of the ſecond and third *Fractions*, the Product is 180 for a Numerator, which Numerator 180 and Denominator 240 make $\frac{180}{240}$ *l.* for the *Anſwer*, equal to $\frac{3}{4}$ or 15 *s.*

Queſt. 2. If $\frac{2}{3}$ *l* buy $\frac{5}{6}$ Yards of Cloth, what will $\frac{11}{12}$ Yards coſt at that rate?

Anſwer, $\frac{132}{165}$ *l.* equal to $\frac{11}{15}$ *l.* or 14 *s.* 8 *d.*

Queſt. 3. If $\frac{7}{8}$ *l.* coſt $\frac{3}{4}$ *s.* what will $\frac{8}{9}$ *s.* buy?

Anſwer, $\frac{224}{216}$ *l* equal to $1\frac{1}{27}$ *l.*

Queſt 4. If $\frac{3}{5}$ of an Ell of Holland coſt $\frac{1}{3}$ of a Pound, how much will $12\frac{2}{3}$ Ells coſt at that rate?

Anſwer, $\frac{190}{27}$ equal to $7\frac{1}{27}$ *l.*

In reſolving the laſt Queſtion and the two next, obſerve the 3*d* Rule of this Chapter foregoing.

Queſt. 5. If $\frac{9}{10}$ of a C. coſt 284 *s.* what will $7\frac{1}{2}$ C. coſt at that rate?

Anſwer, $239\frac{7}{12}$ *s* or 11 *l* 19 *s.* 7 *d.*

Queſt. 6 If $3\frac{1}{4}$ Yards of Velvet coſt $3\frac{5}{8}$ *l.* how much will $10\frac{1}{2}$ Yards coſt at that rate?

Anſwer, $11\frac{37}{52}$ *l*

Queſt. 7. If 3 Yards of Broad-cloth coſt $2\frac{4}{5}$ *l.* what will $14\frac{1}{7}$ Yards coſt?

Anſwer, 13 *l.* 9 *s.* 4 *d.*

In working the laſt Queſtion and the 4 next, obſerve the 4th Rule of this Chapter foregoing.

Queſt. 8. If 14 *l.* of Pepper coſt 14 *s.* $6\frac{1}{3}$ d. I demand the price of $73\frac{3}{4}$ *l.*?

Anſwer, 3 *l.* 16 *s.* $7\frac{43}{58}$ *d.*

Queſt. 9. If 1 *l.* of Cocheneel coſt 1 *l.* 5 *s.* what will $36\frac{7}{10}$ *l.* coſt?

Anſwer, 45 *l.* 17 *s.* 6 *d.*

Queſt. 10. If one Yard of Broad-cloth coſt $15\frac{5}{8}$ *s.* what will 4 pieces, each containing $27\frac{3}{7}$ Yards coſt at that rate? *Anſwer,* 85 *l.* 14 *s.* $3\frac{2}{7}$*d.*

Queſt. 11. A Mercer bought $3\frac{1}{2}$ pieces of Silk, each piece contain'd $24\frac{2}{3}$ Ells at 6 *s.* $0\frac{3}{4}$*d. per* Ell, I demand the value of $3\frac{1}{2}$ pieces at that rate?

Anſwer, 26 *l.* 3 *s.* $4\frac{3}{4}$*d.*

In reſolving the 4 next Queſtions obſerve the 8th Rule of Chapter 19.

Queſt. 12. If $\frac{2}{5}$ of an Ounce of Silver coſt 2 *s.* I demand the price of $11\frac{2}{3}$ *l.* at that rate? *Anſwer* 35 *l.*

Queſt. 13. If $1\frac{5}{7}$ *l.* of Gold is worth $61\frac{5}{7}$ *l. Sterling,* what is a Grain worth at that rate?

Anſwer, $1\frac{1}{2}$*d.*

Queſt. 14. If $\frac{3}{4}$ yds. of Silk is worth $\frac{3}{4}$ of $\frac{5}{6}$ *l.* what is the price of $15\frac{2}{5}$ Ells *Flemiſh*?

Anſwer, 9 *l.* 12 *s.* 6 *d.*

Queſt. 15 If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves coſt 6 *s.* $2\frac{2}{7}$ *d.* what coſt the C. weight at that rate?

Anſwer, 69 *l.* 6 *s.* 8 *d.*

Note that when the Anſwers to the Queſtion in this and the next Chapter are given in Fractions, they are given in their loweſt Terms.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

1. IT hath been already taught (in the third Rule of the 11th Chapter) how to diſcover when the 4th proportional Number (to the three given Numbers) is to be found out by a Rule of 3 Direct, and when by a Rule of 3 Inverſe, to which Rule the Learner is now referred.

2. When (in Fractions) you find a Queſtion to be ſolved by the *Rule of Three Inverſe,* viz. when the third Term is the Diviſor, then having reduced the Terms

exactly (according to the Rules in Chap. 24) multiply the Numerators of the 3 Fractions into the Denominators of the ſecond and firſt Fractions, and the Product is a new Denominator; then multiply the Denominator of the third Fraction into the Numerators of the ſecond and firſt Fractions, and the Product is a new Numerator, which new Fraction thus found is the Anſwer to the Queſtion.

Queſt. 1. If $\frac{3}{4}$ of a Yard of Cloth that is 2 *yards* wide will make a Garment how much of any other Drapery that is $\frac{3}{5}$ of a Yard wide will make the ſame Garment?

Anſwer, $2\frac{1}{2}$ Yards.

Queſt. 2. I lent my Friend 46 *l.* for $\frac{4}{5}$ of a Year, how much ought he to lend me for $\frac{7}{12}$ parts of a Year?

Anſwer, $63\,\frac{3}{5}$ *l.*

Queſt. 3. If $\frac{2}{3}$ of a Yard Cloth that is $2\frac{1}{3}$ Yards wide will make any Garment, what breadth is that Cloth when $1\frac{3}{4}$ Yard will make the ſame Garment?

Anſwer, $\frac{56}{63}$ of a Yard wide.

Queſt. 4. How many Inches in length of a Board that is 9 Inches broad will make a Foot ſquare?

Anſwer, 6 Inches in length.

Queſt. 5. If when the Buſhel of Wheat coſt $4\frac{3}{4}$ *s.* the Penny-Loaf weighed $10\frac{2}{3}$ Ounces, what will it weigh when the Buſhel coſt $8\,\frac{9}{10}$ *s*?

Anſwer, $5\,\frac{185}{2{,}67}$ Ounces.

Queſt. 6. If 12 Men can Mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ Days in how many Days will 6 Men do the ſame?

Anſwer, In $21\,\frac{1}{3}$ Days.

CHAP. XXVI.

Rules of Practice.

IN the Single Rule of Three, when the firſt of the 3 Numbers in the Queſtions (after they are diſpos'd according to the 6th Rule of Chapter 10) happeneth to be an Unit (or 1) that Queſtion many times may be reſolv'd far more ſpeedily than by the *Rule of Three*, which Kind of Operation is commonly call'd *Practice*, and indeed it is of excellent Uſe among Merchants, Tradeſmen and others, by reaſon of its ſpeedineſs in finding a Reſolution to ſuch Kind of Queſtions.

2 The chiefeſt Queſtions reſolvable by theſe brief Rules may be comprehended under the ſeven general Heads or Caſes following, *viz.*

When the given price of the Integer conſiſts
1 Of *Farthings under* 4.
2 Of *Pence under* 12.
3 Of *Pence and Farthings.*
4 Of *Shillings under* 20.
5 Of *Shillings, Pence and Farthings.*
6 Of *Pounds.*
7 Of *Pounds, Shillings, Pence and Farthings.*

It would be very convenient for the Practical Arithmetician to have by heart the ſeveral Products of the 9 Digits multiply'd by 12, for his ſpeedy reducing Pence into Shillings, and Shillings into Pence, which he may gain by the following Table.

12 Times	1	12
	2	24
	3	36
	4	48
	5	60
	6	72
	7	84
	8	96
	9	108

3. Shillings are practically reduced into Pound thus, *viz.* Cut off the Figure ſtanding in the place o Units with a daſh of the Pen, and note it for Shillings then draw a Line under the given Number, and tak

hal

half of the remaining Figures (after the firſt is cut off) and ſet them under the Line, and they are ſo many Pounds, but if the laſt Figure is odd, than take the leſſer half, and add 10 to the Figure ſo cut off (as before) for Shillings, as if I were to reduce 43658 Shillings into Pounds, firſt I cut off the laſt Figure (8) for Shillings, then I take half of the remaining Figures (4365) thus, half of 4 is 2, which I put under the Line, the $\frac{1}{2}$ of 3 is 1, and becauſe 3 is an odd Number, I make the next Figure 6 to be 16, and I go on ſaying, $\frac{1}{2}$ of 16 is 8, and then $\frac{1}{2}$ of 5 is 2, which is the laſt Figure; wherefore becauſe 5 is an odd Number, I add 10 to the 8 I cut off, and it makes 18 *s.* ſo that I find it to be 2182 *l.* 18 *s.* as *per* Margent.

l.	*s.*
4365	8
2182	18

4. It is likewiſe convenient that the Learner be acquainted with the Practical Tables following, the firſt containing the Aliquot or even Parts of a Shilling, the ſecond contain the Aliquot parts of a Pound.

The even Parts of a Shilling.		is
	6	$\frac{1}{2}$
	4	$\frac{1}{3}$
	3	$\frac{1}{4}$
	2	$\frac{1}{6}$
	1$\frac{1}{2}$	$\frac{1}{8}$
	1	$\frac{1}{12}$

The even Parts of a Pound.			is
	10	0	$\frac{1}{2}$
	6	8	$\frac{1}{3}$
	5	0	$\frac{1}{4}$
	4	0	$\frac{1}{5}$
	3	4	$\frac{1}{6}$
	2	6	$\frac{1}{8}$
	2	0	$\frac{1}{10}$
	1	8	$\frac{1}{12}$
	1	0	$\frac{1}{20}$

Caſe 1.

5. When the price of the Integer is a Farthing, then take the 6th part of the given Number, which will be ſo many Three-half-pences, and if any thing remains it is Farthings by the 7th Rule of Chapter 9, then conſider that Three-half-pence is $\frac{1}{8}$ of a Shilling, wherefore take the eighth part of them for Shilings, and if any thing remain, they are ſo many Three-half-pences, which reduce into Pounds by the 3d Rule foregoing. *Example*, What comes 67486*l.* to, at a Farthing *per l.* First, I take $\frac{1}{6}$ of 67486, and it is 11247 Three-half-pence and 4 Farthings, or 1 Penny; then $\frac{1}{8}$ of 11247 is 1405 s. and 7 remains, which is 7 Three-half-pences, or 10$\frac{1}{2}$*d.* which with the 4 Farthings before make 11$\frac{1}{2}$*d.* and 1405 Shillings which by the 3d Rule is 70 *l.* 5 *s.* In all 70 *l.* 5 *s.* 11 $\frac{1}{2}$ *d.* for the *Anſwer.* See the Work following.

	d.
$\frac{1}{6}$	67486 *at* $\frac{1}{4}$ *per l. facit.*
	d.
$\frac{1}{8}$	11247 — 1
$\frac{1}{20}$	140|5 — 10$\frac{1}{2}$
	l. *s.* *d.*
	70—5—11$\frac{1}{2}$ *facit.*

Other Examples follow.

$\frac{1}{6}$	8576 *l. at* 1 *qr.*	$\frac{1}{6}$	6380 *l. at* 1 *qr.*
$\frac{1}{8}$	1429 — 2 *qrs.*	$\frac{1}{8}$	1063 — 2 *qrs.*
$\frac{1}{20}$	17|8 — 8 *d.*	$\frac{1}{20}$	13|2 — 11 *d.*
	l. *s.* *d.*		*l.* *s.* *d.*
	8—18—8 *facit.*		6—12--11 *fac.*

When

6. When the price of the Integer is 2 Farthings, then take the third part of the given Number for ſo many Three-Half-pences, and the Remainder (if any) is Half-pence, then take the eighth part of that for Shillings, as before, *&c.*

Example.

$\frac{1}{3}$	7368 *l. at* 2 *qrs.*
$\frac{1}{8}$	2456
$\frac{1}{20}$	30|7
	l. *s.*
	15—7 *facit.*

$\frac{1}{3}$	8347 *l. at* 2 *qrs.*
$\frac{1}{8}$	2782 —— 2 *qrs.*
$\frac{1}{20}$	34|7 —— 9 *d.* ½
	l. *s.* *d.*
	17—7—9½ *facit.*

7. When the price of the Integer is 3 Farthings, then take half the given Number for Three-half-pence, and if any thing remain it is 3 Farthings; then take the eighth of that for Shillings, as before, *&c.*

$\frac{1}{2}$	4736 *l. at* 3 *qrs.*
$\frac{1}{8}$	2368
$\frac{1}{20}$	29|6
	l. *s.*
	14—16 *facit*

$\frac{1}{2}$	5425 *l. at* 3 *qrs.*
$\frac{1}{8}$	2712 —— 3 *qrs.*
$\frac{1}{20}$	33|9
	l. *s.* *d.*
	16—19—0—3 *fa.*

Caſe 2.

8. When the given price of the Integer, is a part or parts of a Shilling (*viz.* Pence) divide the given Number of Integers (whoſe value is ſought) by the Denominator of the Fraction repreſenting the even part, and the Quote is Shillings (always minding the 7th Rule of the 9th Chapter) and thoſe Shillings may be reduced into Pounds by the 3d Rule of this Chapter. *Example,* Let it be required to find the Value of 438 *l.*

at 3 *d. per l.* I conſider 3 *d.* is $\frac{1}{4}$ of a Shilling, and 438 *l.* will coſt ſo many 3 Pences, wherefore I divide 438 by 4 the Denominator of $\frac{1}{4}$ and the Quote is 109 Shillings, and 2 remains, which is 2 Three-pences or 6 *d.* the whole Value is 5 *l.* 9 *s.* 6 *d.* as by the following Work appeareth.

$\frac{1}{4}$	438 *l. at* 3 *d.*
$\frac{1}{20}$	10|9——6
	l. s. d.
Facit,	5—9—6

More Examples follow.

	l. d.
$\frac{1}{2}$	3574 *at* 6 *per l.*
$\frac{1}{20}$	17|87
	facit 89 *l.* 7 *s.*

	l.
$\frac{1}{6}$	5316 *at* 2 *d. per l.*
$\frac{1}{20}$	88|6
	facit 44 *l.* 6 *s.*

	l. d.
$\frac{1}{3}$	438 *at* 4 *per l.*
$\frac{1}{20}$	4 6
	facit 7 *l.* 6 *s.*

	l. d.
$\frac{1}{8}$	6389 *at* 1$\frac{1}{2}$ *per l.*
$\frac{1}{20}$	79|8—7 *d.* $\frac{1}{2}$
	facit 39 *l.* 18 *s.* 7 *d.* $\frac{1}{2}$.

	l. d.
$\frac{1}{4}$	879 *at* 3 *per l.*
$\frac{1}{20}$	21|9—9 *d*
	facit 10 *l.* 19 *s.* 9 *d.*

	l. d.
$\frac{1}{12}$	818 *at* 1 *per l.*
$\frac{1}{20}$	6|8—2 *d.*
	3 *l.* 8 *s.* 2 *d. facit.*

9. If the price of the Integer be Pence under 12, and yet not an even part, then it may be divided into even parts, and ſo the parts of the given Numbers ta-

ken accordingly, and added together, as if it were 5 *d.* which is 3 *d.* and 2 *d.* *viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a Shilling, firſt take $\frac{1}{4}$ of the given Number, and then $\frac{1}{6}$ thereof, and add them together, and their Sum is the Anſwer in Shillings, ſtill obſerving Rule 7 of Chap. 9 for the Remainder (if any be) then bring the Shillings into Pounds by the 2d Rule foregoing. Likewiſe 7 *d.* is $\frac{1}{3}$ and $\frac{2}{4}$, ſo 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$, and 10 *d.* is $\frac{1}{4}$ and $\frac{1}{4}$ and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a Shiling, or elſe many times your work may be ſhorten'd thus, *viz.* when the ſaid given price is to be divided into even parts of a Shilling or of a Pound. After you have taken the firſt even part, the other may be an even part of that part, as in the next Example, where is given 439 *l.* at 5 *d. per l.* now I may divide it thus, *viz.* into 4 *d.* 1 *d.* and 4 *d* being $\frac{1}{3}$ of a ſhilling, and 1 *d.* being $\frac{1}{4}$ of 4 *d.* I firſt take $\frac{1}{3}$ of 439 *l.* and it gives 146 *s.* 4 *d.* and for the 1 *d.* I take $\frac{1}{4}$ of 146 *s.* 4 *d.* which is 36 *s.* 7 *d.* which in all comes to 9 *l.* 2 *s.* 11 *d.* Examples follow.

	l. d.		yds. d.
	439 *at* 5 *per l.*		417 *at* 9 *per yd.*
$\frac{1}{3}$	146——4	$\frac{1}{2}$	208——6
$\frac{1}{4}$	36——7	$\frac{1}{2}$	104——3
	18|2——11		31|2——9
	9*l.* 2*s.* 11*d. facit.*		15*l.* 12*s.* 9 *d. facit.*
	ells. d.		ells d.
	587 *at* 7 *per ell.*		186 *at* 10
$\frac{1}{3}$	195——8	$\frac{1}{2}$	193
$\frac{1}{4}$	146——9	$\frac{1}{4}$	1 8——8
	34|2——5		32|1——8
	17*l.* 2*s.* 5*d. facit*		16 *l.* 01*s.* 8*d. facit.*

	yds. d.
	836 *at* 8 *per yd.*
⅓	278—8
	278—8
	55|7—4
	27*l.* 17*s.* 4*d. facit*

	l. d.
	534 *at* 11
⅓	178
⅓	178
¼	133—6
	48|9—6
	24 *l.* 9 *s.* 6 *d. facit.*

Caſe 3.

16. When the Price of the Integer is Pence and Farthings, if it make an even part of a Shilling, Work as before; but if they are uneven, as Penny Farthing, Penny three Farthings, 2 *d.* 1 *qr* or 2 *d.* 3 *qrs.* 3 *d.* 3 *qrs.* or the like, then firſt work for ſome even part, and then conſider what part the reſt is of that even part, and divide that Quotient thereby, then add them together, and reduce them to Pounds as before. *Example*, 3470 *l.* at 1 *d.* 1 *qr per l.* firſt I work for the Penny by dividing 3470 *l.* by 12, for 1 *d.* is $\frac{1}{12}$ of a Shilling, and the Quote is 289 *s.* 2 *d* then I conceive that one Farthing is the ¼ of a Penny, and the Value of 1 Farthing will be ¼ of the Value of a Penny, and therefore I take ¼ of 289 *s.* 2 *d* which is 72 *s.* 3 *d.* 2 *qrs.* and add them together, and they are 18 *l.* 1 *s.* 5 *d.* 2 *qrs.* as by the Margent. Other Examples of the ſame Nature follow.

	l. d. qrs.
	3470 *at* 1 3
¼	289—2
	72—3—½
$\frac{1}{20}$	36|1—5—2
	l. s. d. qrs.
	18 1—5—½

l. *d.*
$\frac{1}{12}$ 4360 at $1\frac{1}{4}$

$\frac{1}{4}$ 363—4
90—10

45|4—2

l. *s.* *d.*
22—14—2 *facit.*

yds. *d.*
$\frac{1}{8}$ 573 *at* $1\frac{3}{4}$

$\frac{1}{6}$ 71—7 $\frac{1}{2}$ *d.*
11—11$\frac{1}{4}$

8|3—6$\frac{3}{4}$

l. *s.* *d.*
facit 4--3--6$\frac{3}{4}$

$\frac{1}{6}$ 485 *l. at* 2 $\frac{1}{4}$ *d.*

$\frac{1}{8}$ 80—10 *d.*
10—1$\frac{1}{4}$

9|0—11$\frac{1}{4}$

4 *l.* 10 *s.* 11 $\frac{1}{4}$ *d.*

$\frac{1}{2}$ 520 *yds. at* 7 $\frac{1}{2}$

$\frac{1}{4}$ 260
65

32|5

16 *l.* 5 *s. facit.*

$\frac{1}{6}$ 654. *at* 2 *d.*

$\frac{1}{4}$ 109
27—3 *d.*

13|6—3

6 *l.* 16 *s.* 3 *d.*

137 *yds.* at 10 $\frac{1}{2}$

$\frac{1}{2}$ 68—6 *d.*
$\frac{1}{2}$ 34—3
$\frac{1}{8}$ 17—1 $\frac{1}{2}$ *d.*
11|9—10 $\frac{1}{2}$ *d.*

5 *l.* 19 *s.* 10$\frac{1}{2}$ *d. fa.*

Caſe 4.

11. When the price of the Integer is 2 *s.* then cut off the Figure in the place of Units of the given Number, and double it for Shillings, and the Figures on the other hand are Pounds: *Example*, 436 Yards at 2 *s. per* Yard, cut off the laſt Figure 6 and double it, it makes 12 Shillings, and the other two Figures, *viz.* 43 are ſo many Pounds; ſo that their Value is 43 *l.* 12 *s.* as *per* Margent.

43|6

43*l.* 12*s.*

12. Hence it is evident that when the given price of an Integer is an even number of Shillings, then if you take half of that (even) number of Shillings, and multiply the given number of Integers thereby, doubling the firſt Figure of the Product, and ſetting it a-part for Shillings, the reſt of the Product will be Pounds, which Pounds and Shillings are the Value ſought. *Example 1* What coſt 536 Yards at 8 *s. per yd.*? To reſolve which I take $\frac{1}{2}$ of 8 *s.* (the price of a Yard) which is 4, and multiply 536 thereby, ſaying, 4 times 6 is 24, then I double the firſt Figure 4 makes 8 for Shillings, and carry 2 to the next Product, *&c.* I find the reſt of the Product to be 214, which I note for Pounds, ſo the Value of 536 *yds.* at 8 *s. per yd.* is 214 *l.* 8 *s.* as *per* Margent. More Examples follow.

536 *yds.* at 8*s.*

214 *l.* 8 *s.*

56 *yd.* at 6 *s. per yd.*	420 *yds.* at 12 *s. per yd.*
16 l. 16 s. *facit.*	252 *l. facit.*
123 *yds.* at 4 *s. per yd.*	326 *yds.* at 14 *s. per yd.*
24 *l.* 12 *s. facit.*	228 *l.* 4 *s. facit.*
48 *ells at* 8 *s. per ell.*	48 *yds.* at 16 *s. per yd.*
19 *l.* 4 *s. facit.*	38 *l.* 8 *s. facit.*
84 *yds. at* 10 *s. per yd.*	52 *yds.* at 8 *s. per yd.*
42 *l. facit.*	46 *l.* 6 *s. facit.*

13. If the given price of the Integer is an odd Number of Shillings, then work firſt for the even Number of Shillings by the laſt Rule, and for the odd Shilling take $\frac{1}{20}$ of the given Number of Integers, according to the 3d Rule of this Chapter, and add them together, and you have your Deſire. Examples follow.

yds. *s.*	*ells* *s.*
422 *at* 3 *per. yard.*	431 *at* 13
l. *s.*	*l.* *s.*
42 —— 4	258 —— 12
21 —— 2	21 —— 11
63 —— 6 *facit*	280 —— 03 *facit.*
ells. *s.*	*ells.* *s.*
516 *at* 7 *per. ell.*	324 *at* 17 *per ell.*
l. *s.*	*l.* *s.*
154 —— 16	259 —— 04
25 —— 16	16 —— 04
180 —— 12 *facit.*	275 —— 08 *facit.*

14. Except when the given price of the Integer is 5 *s* for then it is ſooner anſwered by taking $\frac{1}{4}$ of the given number whoſe Value is ſought, as in the following Example.

	yds. *s.*		*ells* *s.*
$\frac{1}{4}$	436 *at* 5 *per yd.*	$\frac{1}{4}$	206 *at* 5 *per ell*
	109 *l. facit.*		51 *l.* 10 *s. facit.*

Caſe 5.

15. When the given price of an Integer is ſhillings and pence, or ſhillings, pence and farthings; then if the ſhillings and pence be an even part of a pound, divide the given number of Integers, whoſe value you ſeek by the denominator of that Fraction repreſenting that even part. As for Example, what is the price of 384 *yards* at 6 s. 8 *d. per* yard? Here I conſider that 6 *s.* 8 *d.* is $\frac{1}{3}$ of a pound,

wherefore divide 384 by 3, and the Quote is the Anſwer, *viz.* 128*l.* ſo that 384 *yds.* at 6 *s.* 8 *d.* *per yd.* amounts to 128 *l.* as *per* Margent, ſtill obſerving the 7th Rule of the 9th Chapter.

$\frac{1}{3}$	384
	128 *l. facit.*

More Examples follow.

$\frac{1}{3}$	438 *ells at* 6*s.* 8*d.*	$\frac{1}{8}$	443 *yds. at* 2 *s.* 6 *d.*
	146 *l. facit.*		55 *l.* 7 *s.* 6*d. facit.*
$\frac{1}{6}$	525 *at* 3 *s.* 4 *d.*	$\frac{1}{12}$	726 *yds. at* 1 *s.* 8 *d.*
	87 *l.* 10 *s. facit.*		60 *l.* 10 *s. facit.*

16. When the given Value of the nteger is Shillings and Pence, and not an even part of a Pound, yet many times it may be divided into parts (*viz.* 6 *s.* 6 *d.* is 4 *s,* and 2 *s.* 6 *d.* for the 4 *s.* Work according to the 12th Rule foregoing, and for the 2 *s* 6 *d.* take the eighth part of the given Number, and add them together, then their Sum is the Value required.)

So 8 *s.* 6 *d.* will be divided into 6 *s.* and 2*s.* 6 *d.* and the price of the given Number may be found out as before, *&c.* Examples follow:

	yds. *s.* *d.*		*ells* *s.* *d.*
	386 at 8—8	*s.*	540 at 5—4
$\frac{1}{3}$	128 *l.*—13—4	2	54*l.* —0 *s.*
$\frac{1}{10}$	38 —12—0	$\frac{1}{6}$	90——0 *s.*
	167*l.* 5*s.* 4*d.facit*		144 *l. facit.*
	ells. *s.* *d.*		*yds.* *s.* *d.*
s.	427 at 8—6	*s.*	386 at 14—8
6	128 *l*——2—0	8	154*l.*—8—0
$\frac{1}{8}$	53——7—6	$\frac{1}{3}$	128—13—4
	181*l.* 9 *s.* 6*d. fac.*		283*l.* 1*s.* 4*d* *fac.*

17. When the given price of the Integer is Shillings and Pence, and you cannot readily divide them according to the laſt Rule, then multiply the given Number, whoſe Value you ſeek, by the number of Shillings in the price of the Integer, and then for the Pence work by the 8th Rule foregoing; then add the Numbers together, and their Sum is the Value ſought in Shillings; as for *Example*, What is the Value of 392 *yds* at 6 *s*. 9 *d*. *per yd* Here 6 *s*. 9 *d* cannot be made any even part, nor indeed can it be divided into even parts of a Pound; wherefore I multiply the given number of *yds*. 392 by 6, for the 6*s* the Product is 2352 Shillings, then for the 9 *d*. I divide it into 6 *d*. and 3 *d*. and work for them by the 8th Rule foregoing, and at laſt add the Shillings together, they make 2646*s* and by the 3d Rule they are reduced to 132 *l*. 6 *s*. the Value of 392 *yds*. at 6 *s*. 9 *d*. *per* Yard. See the Work following.

yds. *s*. *d*.
392 *at* 6—9 *d*.
2352
$\frac{1}{2}$ 196
$\frac{1}{4}$ 98
264|6
132 *l*. 6 *s*. *facit*.

Other Examples follow.

l. *s*. *d*.
s. 480 *at* 4—10 *d*.
$\frac{1}{2}$ 1920
$\frac{4}{1}$ 240
160
232|0
116 *l*. *facit*.

Ells. *s*. *d*.
s. 732 *at* 12—7
12
8784
$\frac{1}{3}$ 244
$\frac{3}{4}$ 183
921|1
460 *l*. 11 *s*. *facit*.

18. When the given price of the Integer is Shillings, Pence and Farthings, then multiply the given Number of Integers by the Number of Shillings contain'd in the value of the Integer, and for the Pence and Farthings follow the 10th Rule of this Chapter.

Examples.

	yds. *s.* *d.*
s.	438 *at* 8 — 6 ¾
8	3504
½	219
⅛	27 — 4½ *d.*
	375|0 — 4 ½
	fac. 187 *l.* 10 *s.* 4½ *d.*

	ells. *s.* *d.*
	370 *at* 14 — 2 ¾
	1480 —
s.	370
14	5180 *d.*
⅙	61 — 8
¼	15 — 5
½	7 — 8 ½
	526|4 — 9½
	fac. 263 l. 4 *s.* 9½ *d.*

	ells. *s.* *d.*
s.	136 *at* 9 — 2½
9	1224 — 0 *d.*
⅙	22 — 8
¼	5 — 8
	125|2 — 4
	fac. 62 *l.* 12 *s.* 4 *d.*

	ells. *s.* *d.*
	431 *at* 2 — 4 ½
2	862
¼	107 — 9 *d.*
⅛	53 — 10½
	102|3 — 7 ½
	fac. 51 *l.* 3 *s.* 7½ *d.*

Caſe 6.

19. When the given Value of the Integer is Pounds then multiply the Number of Integers whoſe Value is ſought by the price of the Integer, and the Product is the Anſwer in Pounds.

Examples.

C. l. 42 *at* 2 *per* C. 48 *l. facit.*	C. l. 13 *at* 8 *per* C. 104 *l. facit.*
C. l. 30 *at* 3 *per* C. 90 *l. facit.*	C. l. 48 *at* 1 *per* C. 376 *l. facit.*

Caſe 7.

20. If the price of the Integer is Pounds and Shillings, then for the Pounds work as in the laſt Rule and for the Shillings as in the 12th and 13th Rules beforegoing, then add the Numbers produc'd from them both, and the Sum is the Value ſought.

Examples.

	C.	*l.*	*s.*
	46 *at*	2 —	4
2*l.*	92		*s.*
4*s.*	9 —		4
	101 *l.*	4 *s. facit*	

	groſs	*l.*	*s.*
	82 *at*	4 —	10
4*l.*	328		
10*s.*	41		
	369 *l. facit.*		

	groſs	*l.*	*s.*
	58 *at*	3 —	7
3*l.*	174		*s.*
6*s.*	17 —		8
1*s.*	2 —		18
	194 *l.*	6 *s. facit.*	

	groſs	*l.*	*s.*
	26 *at*	3 —	15
3*l*	78		
14*s.*	18 —		4
1*s.*	1 —		6
	97 *l.*	10 *s. facit.*	

21. When the given price of an Integer conſiſts of *Pounds*, *Shillings* and *Pence*, with *Farthings*, then work for the *Shillings*, *Pence* and *Farthings*, firſt according to the 18*th* Rule of this Chapter, and find the Total Value of the given Number, as if there were no *Pounds*, then work with the *Pounds* according to the 19th Rule of this Chapter, and add the Numbers thus found, and their Sum is the Total Value required.

Examples of this Rule follow.

	C. *l.* *s.* *d.*
	213 *at* 1—13—4½
	639
	213
13 *s.*	2769 *d.*
3 *d.*	53——3
1½ *d.*	26——7½
	284|8——10½
1 *l.*	142 *l.* 08 *s.* 10½ *d.*
	213
	355 *l.* 8 *s.* 10½ *d. facit,*

C. *l.* *s.* *d.*	
37 *at* 3—8—10½	
296 *d.*	8 *s.*
18—6	6 *d.*
9—3	3 *d.*
4—7½	1½ *d.*
32|8 -- 0½ *d.*	
16 *l.* 8 *s.* 4½ *d.*	
111	3 *l.*
127 *l.* 8 *s.* 4½ *d. fac.*	

	groſs *l.* *s.* *d.*
	416 *at* 2—9—3¾
9 *s.*	3744
3 *d.*	104
¾ *d.*	26
	387|4
	193 *l.* 14 *s.*
2 *l.*	832
	1025 *l.* 14 *s.* *facit.*

groſs *l.* *s.* *d.*	
48 *at* 3—15—11½	
240	
48	
720	15 *s.*
24	6 *d.*
16	4 *d.*
6	1½ *d.*
76|6	
38—6	
144	3 *l.*
182 *l.* 6 *s.* *facit.*	

22. When there is given the Value of an Integer, and it is required to know the Value of many ſuch Integers together, with ¼ or ½ or ¾ of an Integer, then firſt by the (former Rules) find out the Value of the given Number of Integers, and then for ¼ of an Integer take ¼ of the given Value of the Integer, or for ½ take ½ of the given Value, and then ½ of that ½ ſetting each Part under the Precedent, then adding them together, their Sum will be the required Value of the Integers and their Parts, *Example*, What is the Value of 116½ *yds.* at 4 *s.* 6 *d.* *per Yard*? To give an Anſwer, Firſt I work for the Value of 116 *yds.* by the 15th Rule foregoing, and then for the ½ *yds.* I take ½ of 4 *s* 6 *d.* which is 2 *s.* 3 *d.* and add to the reſt found as before, then is that Sum the total Value of 116½ *yds.* at 4 *s.* 6 *d.* *per yd.* which I find to amount to 26 *l.* 4 *s.* 3 *d.* as by the Work in the Margent.

yds. *s.* *d.*
116½ *at* 4—6

11 *l.* 12 *s.*	2 *s.*
14 *l.* 10 *d.*	2 *s.* 6 *d.*
2—3	½ *yd.*

25—4—3 *Facit.*

Other Examples follow.

324¼ *yds.* *at* 4 *s.* 10 *d.*

1296	4 *s.*
162	6 *d.*
108	4 *d.*
1—2*d.*	½ *yd.*

156|7 *s.* 2½ *d.*
78 *l.* 7 *s.* 2½ *d.* *facit.*

228¾ *ells* at 12 *s.* 11 *d.*

2730	12 *s.*
76	4 *d.*
76	4 *d.*
57	3 *d.*
6—5½ *l.*	½ *ell.*
3—2¼ *d.*	¼ *ll.*

295|4— 8¼ *l*
247 *l.* 14 *s.* 8¼ *d.* *facit.*

720 *yds.* *at* 6 *s.* 8 *d.*
240 *l.* 3 *s.* 4 *d.* *Facit.*

C. *qrs* *l.* *l.* *s.* *C.*
28—3—14 *at* 1 10 *per*

28 *l.*	1 *l.*
14	10 *s.*
00—15 *s.*	½ *C.*
7 *s.* 6 *d.*	¼ *C.*
3*s.* 9*d.*	14 *l.*

43 *l.* 6 *s.* 3 *d.* *facit.*

Many more Queſtions might be ſtated, and ſeveral other Rules of *Practice* may be ſhewn according to the Method of divers Authors; but what have been delivered here are ſufficient for the Practical Arithmetician in all Caſes whatſoever.

CHAP. XXVII.

The Rule of Barter.

1. BARTER is a Rule amongſt Merchants, which (in the Exchanging of one Commodity for another) informs them ſo to proportion their Rates, as that neither may ſuſtain Loſs.

2. To reſolve Queſtions in *Barter*, it will not be difficult to him that is acquainted with the Golden Rule, or Rule of Three, it being altogether uſed in reſolving ſuch Queſtions.

Queſt. 1. Two Merchants (*viz.* A and B) Barter. A hath 13 C. 3 *qrs.* 14 *l.* of Pepper, at 2 *l.* 16 *s* *per* C. and B hath Cotton at 9 *d. per l.* I demand how much Cotton B muſt give A for his Pepper?

Anſwer, 9 C. 1 *qr*.

Firſt find by the Rule of Three, or the Rules of Practice foregoing, how much the Pepper is worth, ſaying,

If 1 C coſt 2 *l.* 16 *s.* what will 13 C. 3 *qrs.* 14 *l.* coſt?

Anſwer, 38 *l.* 17 *s.*

Secondly, By the Rule of Three ſay, If 9 *d.* buy 1 *l.* of Cotton, how much will 38 *l.* 17 *s.* buy?

Anſwer, $9\frac{1}{4}$ C. and ſo much Cotton muſt B give to A for 13 C. 3 *qrs.* 14 *l.* of Pepper, at 2 *l.* 16 *s. per Cen*. when the Cotton is worth 9 *d. per l.*

Queſt. 2. Two Merchants (A and B) barter, A hath Ginger worth 1 *l.* 17 *s.* 4 *d per* C. but in Barter he will have 2 *l.* 19 *s. per* C. B hath Nutmegs worth 5 *l.* 12 *s. per* C. now I demand how B muſt rate his Nutmegs *per* C. to make his Gain in Barter equal to that of A?

Anſwer, 8*l.* 8 *s.*

Say by the *Rule of Three,* If 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in Barter, what will 5 *l.* require in Barter?

Facit 8 *l.* 8 *s.*

Queſt. 3. A and B Barter, A hath 120 Yards of Broad-Cloth, worth 6 *s. per yd.* but in Barter he will have 8 *s. per yd.* B hath Shalloon worth 4 *s. per yd.* Now I demand how many Yards of Shalloon B muſt give A for his Broad-Cloth, making his Gain in Barter equal to that of A?

Anſwer, 180 Yards of Shalloon.

Firſt (as in the laſt Queſtion) find out how B ought to ſell his Shalloon in Barter, *viz.* ſay, If 6 *s.* require 8 *s.* what will 4 *s.* require?

Anſwer, 5 *s.* 4 *d.*

Thus you ſee that B muſt ſell his Shalloon in Barter at 5 *s.* 4 *d.* if A ſell his Broad-Cloth at 8 *s. per yd.*

It remaineth now to find out how much Shalloon B muſt give for 120 Yards of Broad-Cloth, which after the ſame Method uſed to reſolve the firſt Queſtion of this Chapter is found to be 180, and ſo many Yards of Shalloon muſt B give A for the 120 Yards of Broad-Cloth.

Queſt. 4. A and B bartered, A had 14 C. of Sugar, worth 6 *d. per l.* for which B gave him 1 C. 3 *qrs.* of Cinnamon, I demand how B rated his Cinnamon *per l.*

Anſwer, 4 *s. per l.*

Queſt. 5. A and B barter, A hath 4 Tun of Brandy, worth 37 *l.* 16 *s.* ready Money, but in Barter he hath 50 *l.* 8 *s. per* Tun, and A giveth B 21 C. 2 *qrs.* 11$\frac{1}{5}$ *l.* of Ginger for the 4 Tun of Crandy, I deſire to know how B ſold his Ginger in Barter *per* C. and how much it was worth in ready Money?

Anſwer, For 9*l.* 6 *s.* 8 *d.* in Barter, and it is worth 7 *l.* *per Cent* in ready Money.

Queſt. 5. A and B Barter, A hath 320 Dozen of Candles, at 4 *s.* 6 *d.* *per* Dozen, for which B giveth him 30 *l.* in Money, and the reſt in Cotton at 8 *d. per l.* I demand how much Cotton he muſt give him more than the 30 *l.*

Anſwer, 11 C. 1 *qr.*

Queſt. 7. A and B Barter: A hath 608 Yards of Broad-cloth, worth 14 *s. per yd.* for which B giveth him 125 *l.* 12 *s.* ready Money, and 85 C. 2 *qrs.* 24 *l.* of Bees-wax, now I deſire to know how he reckon'd his Wax *per* C.

Anſwer, 3 *l.* 10 *s. per Cent.*

CHAP. XXVIII.

Queſtions in Loſs and Gain.

Queſt. 1. A Merchant bought 436 Yards of Broad-Cloth for 8 *s.* 6 *d.* *per* Yard, and ſelleth it again at 10 *s* 4 *d* *per* Yard; now I deſire to know how much he gain'd in the Sale of the 536 Yards?

Anſwer, 39 *l.* 19 *s.* 4 *d.*

Firſt, find out by the Rule of Three, or by *Practice*, how much the Cloth coſt him at 8 *s.* 6 *d.* *per* Yard, which I find to be 185 *l.* 6 *d.* then by the ſame Rule find out how much he ſold it for, *viz.* 225 *l.* 5 *s.* 4 *d.* then ſubtract 185 *l* 6 *s.* which it coſt him, from 225 *l.* 5 *s.* 4 *d.* which he ſold it for, and there remaineth 39 *l.* 19 *s.* 4 *d.* for his Gain in the Sale thereof.

Otherwiſe, it may ſooner be reſolved thus, firſt find out how much he gain'd *per yd.* *viz.* Subſtract 8 *s.* 6 *d.* which he gave *per yd.* from 10 *s.* 4 *d* which he ſold it for *per yd.* the Remainder 1 *s.* 10 *d.* for his Gain *per yd* Then ſay, If 1 *yd.* gain 1 *s.* 10. what will 436 *yds.* gain? The *Anſwer* by *Practice* or the *Rule of Three,* is 39 *l.* 19 *s.* 4 *d.* as was found before.

Queſt. 2. A Draper bought 124 *yds.* of Holland-Cloth, for which he gave 31 *l.* I deſire to know how he muſt ſell it *per yd.* to gain 10 *l.* 6 *s.* 8 *d.* in the whole Sale of the 124 Yards? *Anſwer,* At 6 *s.* 8 *d. per* Yard.

Add the price which it coſt him (*viz.* 31. *l.*) to his intended Gain, (*viz.* 10 *l.* 6 *s.* 8 *d.*) the Sum is 41 *l.* 6 *s.* 8 *d.* Then ſay,

If 124 *yds.* require 41 *l.* 6 *s.* 8 *d.* what will 1 *yd.* require? By the *Rule of Three,* I find the *Anſwer* 6 *s.* 8 *d.*

Queſt. 3. A Grocer bought 3 C. 1 *qr.* 14 *l.* of Cloves, which coſt him 2 *s.* 4 *d. per l.* and ſold them for 52 *l.* 14 *s.* I deſire to know how much he gained in the whole? *Anſwer,* 8 *l.* 12 *s.*

Queſt. 4. A Draper bought 86 Kerſeys for 129 *l.* I demand how he muſt ſell them *per* Piece to gain 15 *l.* in laying out 100 *l.* at that Rate? *Anſwer,* 1 *l.* 14 *s.* 6 *d. per* Piece; for,

As 100 *l.* is to 15 *l.* ſo is 129 *l.* to 148 *l.* 7 *s.*

So that by the Proportion above, I have found how much he muſt receive for the 86 Kerſeys to gain after the Rate of 15 *l. per* C. Then to find how he muſt ſell them *per* Piece, I ſay,

As 86 Pieces are to 148 *l.* 7 *s.* ſo is 1 Piece to 1 *l.* 14 *s.* 6 *d.* which is the Number ſought.

Queſt. 5. A Grocer bought $4\frac{1}{4}$ C. of Pepper for 15 *l.* 17 *s.* 4 *d.* and (it proving to be damnify'd) is willing to loſe 12 *l.* 10 *s. per Cent.* I demand how he muſt ſell it *per l*? *Anſwer,* 7 *d. per l.*

Subtract 12 *l.* 10 *s.* the Loſs of 100 *l.* from 100 *l.* and there remains 87 *l.* 10 *s.* Then ſay,

As 100 *l.* is to 87 *l.* 10 *s.* ſo is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* ſo much he muſt ſell it all for, to loſe after the Rate propounded; Then to know how he muſt ſell it *per l.* I ſay,

As 13 *l.* 17 *s.* 6 *d.* is to $4\frac{1}{4}$ C: ſo is 1 *l.* to 7 *d.*

Queſt. 6. A Plummer ſold 10 Fodder of Lead (the Fodder containing 19$\frac{1}{2}$ C.) for 204 *l* 13 *s.* and gain'd after the rate of 12 *l.* 10 *s. per* 100 *l.* I demand how much it coſt him *per* C? *Anſwer*, 18 *s.* 8 *d.*

To reſolve this Queſtion, add 12 *l.* 10 *s.* (the Gain *per Cent.*) to 100 *l.* and it makes 112 *l.* 10 *s.* then ſay,

As 112 *l.* 10 *s.* is to 100 *l.* ſo is 204 *l.* 15 *s.* to 182 *l.*

Which 182 *l.* is the Sum it coſt him in all; then reduce your 10 Fodders to half hundreds, and it makes 390. Then ſay,

As 390 half hundreds is to 182 *l.* ſo is 2 half Hundreds to 18 *s.* 8 *d.* the Price of 2 half Hundreds or one C. Weight, and ſo much it ſtood him in *per* C. Weight.

Queſt. 7. A Merchant bought 8 Tun of Wine, which being Sophiſticated, he ſelleth for 400 *l.* and loſeth after the Rate of 12 *l.* in receiving a 10 *l.* Now I demand how much it coſt him *per* Tun? And how he ſelleth *per* Gallon to loſe after the ſaid rate? *Anſwer*, It coſt 56 *l. per* Tun, and he muſt ſell it at 3 *s.* 11 *d.* 2$\frac{10}{21}$ *qrs. per* Gallon to loſe 12 *l.* in receiving 100 *l.*

To reſolve this Queſtion, I conſider in the firſt place that in receiving 100 *l.* he loſeth 12 *l.* therefore 100 *l.* comes in for 112 *l.* laid out; wherefore to find how much he laid out for the whole, I ſay,

As 100 *l.* is to 112 *l.* ſo is 400 *l.* to 448 *l.* and ſo much the 8 Tun coſt him: Then to find how much it coſt *per* Tun, I ſay,

As 8 is to 448 *l.* ſo is 1 to 56 *l.* the price it coſt *per* Tun.

Now to find how he muſt ſell it *per* Gallon, reduce the 8 Tuns into Gallons, they make 2016. Then ſay,

As 2016 Gallons is to 403 *l.* ſo is 1 Gallon to 3 *s.* 11 *d.* 2$\frac{10}{21}$ *qrs.* the price he muſt ſell it at *per* Gallon to loſe as aforeſaid.

Queſt. 8. A Merchant bought 8 Tuns of Wine, which being ſophiſticated, he is willing to Sell for 400 *l.* and loſeth at that Rate 12 *l.* in laying out 100 *l.* upon the ſame, now I demand how much it coſt him *per* Tun?

Here I conſider that for 100 *l.* laid out, he receiveth but 88 *l.* therefore to find what the 8 Tuns coſt him, I ſay,

As 88 *l.* is to 100 *l.* ſo is 400 *l.* to 454 $\frac{6}{11}$ the price it all coſt him, then to find how much *per* Tun, I ſay,

As 8 is to 454 $\frac{6}{11}$ ſo is 1 to 56 $\frac{9}{11}$ or 56 *l.* 16 *s.* 4 *d.* 1 $\frac{5}{11}$ *qr. per* Tun.

CHAP. XXIX.

Equation of Payments.

1. EQuation of Payments is that Rule amongſt Merchants whereby we reduce the Times for Payments of ſeveral Sums of Money to an equated Time for Payment of the whole Debt, without Damage to Debtor or Creditor; and,

The Rule is,

2. Multiply the Sums of each particular Payment by its reſpective Time, then add the ſeveral Products together, and their Sum divide by the Total Debt, and the Quotient thence ariſing, is the Equated Time for the Payment of the whole Debt. *Example,*

Queſt. 1. A is indebted to B in the Sum of 130 *l.* whereof 50 *l.* is to be paid at 2 Months, and 50 *l.* at 4 Months, and the reſt at 6 Months, now they agree to make one Payment of the Total Sum, the Queſtion is, What is the Equated Time for Payment, without Damage to Debtor or Creditor?

To reſolve this Queſtion. I multiply each Payment by its Time, *viz.*

50 l. *multiply'd by* 2 *Mon. produceth* ——— 100
50 l. *multiply'd by* 4 *Mon. produceth* ——— 200
50 l. *multiply'd by* 6 *Mon. produceth* ——— 180

The Sum of the Product, is — 480

Then I divide 480 (the Sum of the Product) by 130 (the Total Debt) and the Quotient is $3\frac{9}{13}$ Months for the Time of paying that whole Debt.

Queſt. 2. A Merchant hath owing him 1000 *l.* to be paid as followeth, *viz.* 600 *l.* at 4 Months, 200 *l* at 6 Months, and the reſt (which is 200 *l.*) at 12 Months, and he agreeth with his Debtor to make one Payment of the whole. I demand the time of Payment without Damage to Debtor or Creditor ?

600 l. *multiply'd by* 4 *Months is* ——— 2400
200 l. *multiply'd by* 6 *Months is* ——— 1200
200 l. *multiply'd by* 12 *Months is* ——— 2400

The Sum of the Products is ——— 6000

and the Sum of the Products (6000) being divided by the whole Debt (1000 *l.*) quotes 6 Months for the time of Payment of the whole Debt

3. The Truth of the Rule is thus manifeſt, if the Intereſt of that Money which is paid (by the equated Time) after it is due, be equal to the Intereſt of that Money which (by the Equated Time) is paid ſo much ſooner than it is due at any rate *per C.* then the Operation is true, otherwiſe not. *Example.*

The Proof of the Rule of Equation of Payments.

In the laſt *Queſt.* 600 *l* ſhould have been paid at 4 Months, but is not diſcharged till 6 Months that is 2 Months after it is all due) wherefore its Intereſt for 2 Months at 6 *per Cent. per Ann.* is 6 *l.* and then

200 *l.* was to be paid at 6 Months, which is the equated time for its payment, therefore no Intereſt is reckoned for it; but 200 *l.* ſhould have been paid at 12 Months, but is paid at 6 Months, which is 6 Months ſooner than it ought, wherefore the Intereſt of 200 *l.* for 6 Months, is 6 *l.* (acompting 6 *l. per Cent per Annum*) which is equal to the Intereſt of 600 *l.* for 2 Months, wherefore the Work is right.

Queſt. 3. A Merchant hath owing him a certain Sum to be diſcharged at 3 equal Payments, *viz.* $\frac{1}{3}$ at two Months, $\frac{1}{3}$ at four Months, and $\frac{1}{3}$ at eight Months, the Queſtion is, What is the equated Time for the Payment of the whole Debt?

In Queſtions of this Nature (*viz.* where the Debt is divided into equal or unequal parts) each of the parts is to be multiply'd by its Time, and the Sum of the Product is the Anſwer.

$\frac{1}{3}$ *Multiply'd by* 2 *Mon. produceth* $\frac{7}{3}$
$\frac{1}{3}$ *Multiply'd by* 4 *Mon. produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *Multiply'd by* 8 *M.n. produceth* $2\frac{2}{4}$

The Sum of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ Months for the equated Time of Payment.

If inſtead of the Fractions repreſenting the parts, you had wrought by the Numbers themſelves (repreſented by thoſe parts) according to the firſt and ſecond Example, it would have been the ſame Anſwer; and ſuppoſe the Debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each Payment, *viz.* at 2, 4, and 8 Months. Then

30 *l. Multiply'd by* 2 *Mon. produceth* 60
30 *l. Multiply'd by* 4 *Mon. produceth* 120
30 *l. Multiply'd by* 8 *Mon. produceth* 240

The Sum of the Product is 420

which divided by 90 (the whole Debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{4}$ Months, as before.

Queſt. 4. A Merchant oweth a Sum of Money to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Months, and $\frac{1}{4}$ at 10 Months, and he agreeth with his Creditor to make one total Payment; I demand the Time without Damage to Debtor or Creditor? Work as in the laſt Queſtion, and you will find the Anſwer to be 7 Months.

Queſt. 5. A is indebted to B 642 *l.* whereof he is to pay 40 *l.* preſent Money, 350 *l.* at 3 Months, and the reſt (*viz.* 250 *l.*) at 8 Months, and they agree to make an equated Time for the whole Payment; now I demand the Time?

In Queſtions of this Nature (*viz.* where there is ready Money paid) you are in multiplying to neglect the Money that is to be paid preſent, and work with the reſt as is before directed, and divide the Sum of the Products by the whole Debt, and the Quote is the Anſwer; For here 40 *l.* is to be paid preſent, and hath no Time allow'd; and according to the Rule it ſhould be multiply'd by its Time, which is (0); therefore 40 times 0 is 0, which neither augmenteth nor diminiſheth the Dividend; wherefore to proceed (according to Direction) I ſay,

350 *by* 3 *Months produceth* ——1050
260 *by* 8 *Mouths produceth* ——2000

The Sum of the Product is 3050

which divided by 640, the whole Debt, the Quote is 4$\frac{49}{64}$ Months, the Time of Payment.

Queſt. 6. A is indebted to B in a certain Sum half whereof is to be paid preſent Money, one third at 6 Months, and the reſt at 8 Months; now I demand the equated Time for Payment of it all?

Anſwer, 3$\frac{1}{3}$ Months is the Time of Payment.

Queſt. 7. A is indebted to B 120 *l.* whereof $\frac{1}{3}$ is to be paid at 3 Months, $\frac{1}{4}$ at 6 Months, and the reſt at 9 Months; what is the equated Time fot the Payment of the whole Sum?

Anſwer, At 6 Months.

Queſt. 8. A is indebted to B 420 *l.* which is due at the end of 6 Months, but A is willing to pay him 140 *l.* preſent, provided he can have the remainder forborn ſo much the longer to make Satisfaction for his Kindneſs, which is agreed upon; I deſire to know what Time ought to be allotted for the Payment of the 280 *l* remaining ?

To reſolve this Queſtion, Firſt find out what is the Intereſt of 140 *l.* for the Time it was paid before it was due at 6 *per Cent.* or any other rate (*viz.* 6 Months) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* muſt be detain'd ſo much longer than 6 Months, as the while it may eat out that Intereſt, *viz.* 4 *l.* 4 *s* which is thus found out, *viz.* Firſt, ſee what is the Intereſt of 280 *l.* for a Month, or any other Time; but here we will take one Month, and its Intereſt for one Month is 28 *s.*

Then by the Rule of Three ſay,

As 28 *s.* is to 1 Month, ſo is 84 *s.* to 3 Months; ſo that the 280 *l.* remaining muſt be kept 3 Months, beyond its firſt Time of Payment, (*viz.* 6 Months), which added thereto makes 9 Months, at the end of which Time A ought to make Payment of the Remainder.

CHAP. XXX.

EXCHANGE.

THE Rule of Exchange informeth Merchants how to exchange Monies, Weights or Meaſures of one Country into (or for) the Monies, Weights, or Meaſure of another Country, and when the Rate, Reaſon, or Proportion betwixt the Money, Weights or Meaſures of different Countries is known, it will not be difficult for the Practitioner that is well acquainted with the Rule of Proportion (or Rule of Three) to reſolve any Queſtion, wherein it is required to exchange a given Qaantity of the one kind into the ſame Value of another kind.

2. In Queſtions in Exchange there is always a compariſon made between the Coyns, *&c.* of two Countries (or Kinds) or more

3. In Queſtions where there is a Compariſon made between to Things, (whether they be Monies, Weights, *&c.*) of different Kinds (or Countries) there may be a Solution found by a Single Rule of Three, as may appear by the following Example

Queſt. 1. A Merchant at *London* deliver'd 370 *l. Sterling*, to receive the ſame at *Paris* in *French* Crowns; the Exchange $3\frac{1}{3}$ *French* Crowns *per Pound Sterling.* I demand how many *French* Crowns he ought to receive?

In placing the Numbers, obſerve the 6th Rule of the 11th Chapter, which being done, the given Numbers will ſtand thus,

l. *Crowns* *l.*

1 ——— $3\frac{1}{3}$ ——— 370

and being reduced according to the Rules of the 12th Chapter will ſtand thus:

As $\frac{1}{1}$ is to $\frac{13}{3}$, ſo is $\frac{370}{1}$ to $1233\frac{1}{3}$.

So that I conclude he ought to receive $1233\frac{1}{3}$ *French* Crowns at *Paris* for his 370 *l* deliver'd at *London.*

Queſt. 2. A Merchant deliver'd at *Amſterdam* 587 *l. Flemiſh* to receive the Value thereof at *Naples* in Ducats the Exchange $4\frac{4}{5}$ Ducats *per Flemiſh.* I demand how many Ducats he ought to receive?.

The Proportion is as followeth.

l. *Ducnts* *l.* *Ducats.*

As 1 is to $\frac{24}{5}$, ſo is $\frac{587}{1}$ to $2817\frac{3}{5}$.

So I find he ought to receive $2817\frac{3}{5}$ Ducats at *Naples* for the 587 *l* *Flemiſh* deliver'd at *Amſterdam.*

Queſt 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the Value at *London* in *Pence*, the Exchange at $53\frac{1}{2}$ *Pence Sterling per* Ducatoon; I demand how much *Sterling* he ought to receive?

The Proportion for Reſolution is,

$$\begin{array}{cccccccc} & \textit{Duc.} & & \textit{d.} & & \textit{Duc.} & & \textit{d.} \\ \text{As} & \frac{1}{1} & \text{is to} & \frac{107}{2}, & \text{ſo is} & \frac{3478}{1} & \text{to} & 186073. \end{array}$$

which is equal to 775 *l.* 61 for the Anſwer.

I might here (according to the Cuſtom of Arithmetical Writers) lay down Tables for the Reduction of Foreign Coyns to *Engliſh*; but by Reaſon of their Inſtability (for they continue not at a conſtant Standard, as our *Sterling* Money doth; but are ſometimes raiſed and ſometimes depreſſed) I ſhall forbear.

4. When there is a Compariſon made between more than two different Coyns, Weights, or Meaſures, there ariſeth ordinarily two different Caſes from ſuch a Compariſon.

1. When it is required to know how many pieces of the firſt Coyn, Weight or Meaſure are equal in Value to a known Number of pieces of the laſt Coyn, Weight or Meaſure.

2. When it is required to find out how many pieces of the laſt Coyn, Weight or Meaſure, are equal in Value to a given Number of the firſt Sort of Coyn, Weight or Meaſure.

An Example of the firſt Caſe, may be this, viz.

Queſt. 4. If 150 pence at *London* are equal to 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*; then how many pence at *London* are equal to 138 Shillings at *Bruſſels*? *Facit*, 960 *d.*

The Queſtion may be reſolv'd by two *Single Rules of Three*: For firſt, I ſay,

If $\frac{3}{1}$ Ducats at *Naples* make 150 *d.* at *London*, how many pence will $4\frac{4}{5}$ Ducats make?

Anſwer, 240.

By the foregoing proportion we have diſcovered that $4\frac{4}{5}$ Ducats at *Naples* make 240 pence at

London: And by the Tenor of the Queſtion we ſee that $4\frac{4}{5}$ Ducats at *Venice* make $34\frac{1}{2}$ Shillings at *Bruſſels* therefor 240 *d.* at *London* are equal to $34\frac{1}{2}$ *s.* at *Bruſſels*, (for the things that are equal to one and the ſame thing are alſo equal to one another) wherefore we have a way laid open to give a Solution to this Queſtion by another *Single Rule of Three*, whoſe Proportion is,

As $34\frac{1}{2}$ Shillings at *Bruſſels* is to 243 Pence at *London*, ſo is 131 Shillings at *Bruſſels* to 960 Pence at *London*; which is the Anſwer to the Queſtion.

An Example of the ſecond Caſe, may be thus, viz.

Queſt. 5. If 40 *l.* *Averdupois* weight at *London* is equal to 36 *l.* weight at *Amſterdam*, and 90 *l.* at *Amſterdam* makes 116 *l.* at *Dantzick*, then how many Pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London?*

Anſwer, $129\frac{23}{25}$ *l.* at *Dantzick.*

This Queſtion is likewiſe anſwered by two *Single Rules of Three*, viz. Firſt I ſay,

As 36 *l.* at *Amſterdam* to 40 *l.* at *London*,
So is 90 *l.* at *Amſterdam* to 100 *l.* at *London.*

And by the Queſtion you find that 90 *l.* at *Amſterdam* is 116 *l.* at *Dantzick*; and therefore 100 *l.* at *London* is likewiſe equal thereunto, wherefore again I ſay,

As 100 *l.* at *London* to 116 *l.* at *Dantzick*,
So is 112 *l.* at *London* to $12\frac{9}{1}\frac{2}{2}\frac{3}{5}$ *l.* at *Dantzick.*

By which I find that $129\frac{23}{25}$ *l* at *Dantzick* are equal to 112 *l.* *Averdupois* Weight at *London.*

5. There is a more ſpeedy way to reſolve ſuch queſtions as are contain'd under the two Caſes before mentioned, laid down by Mr. *Kerſey* in the third Chapter of his Appendix to *Wingate's Arithmetick*, there he hath given two Rules for the Reſolution of the queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the Solution of both Caſes; and firſt, Let the Learner obſerve the following Directions in placing of the given Terms, *viz.*

7. Let there be made two Columns, and in theſe Columns ſo place the given Terms one over the other, as that in the ſame Column there may not be found two Terms of the ſame Kind one with the other.

Having thus placed the Terms, the General Rule is, Obſerve which of the ſaid Columns hath the moſt Terms placed in it, and multiply all the Terms therein continually, and place the laſt Product for a Dividend; then multiply the Terms in the other Column continually, and let the laſt Product be a Diviſor, then divide the ſaid Dividend by the ſaid Diviſor, and the quotient thence ariſing is the Anſwer to the *Queſtion*

So the Example of the firſt of the ſaid Caſes being again repeated, *viz.* If 150 Pence at *London* make three Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*, then how many *Pence* at *London* are equal to 138 *Shillings* at *Bruſſels?*

The Terms being placed according to the 7th Rule, will ſtand as followeth.

	A	B	
Pence at *Lond.*	150	3	*Ducats* at *Naples.*
Ducats at *Nap*	$4\frac{4}{4}$	$34\frac{1}{2}$	*Shillings* at *Bruſſels.*
Shill at *Bruſſ.*	138		

Having thus placed the Terms, that in neither Column there is two Terms of one kind, then obſerve that the Column under A hath moſt Terms in it, therefore they muſt be multiply'd together for a Dividend, *viz.* 150 multiply'd by $4\frac{4}{5}$ produceth $\frac{3600}{5}$, which multiply'd by 138, produceth $\frac{496800}{5}$ for a Dividend, then in the Column under B there are 3, and 3 $\frac{1}{2}$ which multiply'd together, produce $\frac{207}{2}$ for a Diviſor; then having divided $\frac{496800}{5}$ by $\frac{207}{2}$ the quotient is 960 *Pence* for the Anſwer, as before.

Again, Let the Example of the ſecond Caſe be again repeated, *viz.* If 40 *l.* *Averdupois* Weight at *London* make 36 *l.* Weight at *Amſterdam*, and 90 *l.* at *Amſterdam* make 110 at *Dantzick*, then how many Pounds at *Dantzick* are equal to 112 *l.* *Averdupois* Weight at *London.*

The Terms being diſpos'd according to the 7th Rule foregoing, will ſtand thus,

	A	B	
l. at Lond.	40	36	*l. at Amſterdam*
l. at Amſt.	90	116	*l. at Dantzick*
		112	*l. at London*

whereby I find that the Terms under B multiply'd together produce 467712 for a Dividend, and the Terms under A, *viz.* 40 and 90 produce 3600 for a Diviſor, and Diviſion being finiſhed, the Quotient giveth $129\frac{3312}{3600}$ Pounds *Dantzick* for the Anſwer.

CHAP. XXXI.

Single Poſition.

1. NEgative Arithmetick, called the Rule of Falſe, is that by which we find out a Truth, by Numbers invented or ſuppos'd, and this either Single or Double.

2. The Rule of Single Poſition, is, when at once, *viz.* by one falſe Poſition, or feign'd Number, we find out the true Number ſought.

3. In the Single Rule of Falſe, when you have made choice of your *Poſition*, work it according to the Tenor of the Queſtion, as if it were the true Number ſought, and if by the ordering your Poſition you find either the Reſult too much or too little, you may then find out the Number ſought by this Proportion following, *viz*

As the Reſult of your Poſition is to the Proportion, ſo is the given Number ſought.

Example.

Queſt. 1. A Perſon having about him a certain Number of Crowns, ſaid, If a Fourth, and third and ſixth of them were added together they would make juſt 45 *l.* now I demand the number of Crowns he had about him?

Anſwer. 60 Crowns.

To reſolve this Queſtion, I ſuppoſe he had 24 Crowns (or any other Number that will admit of the like Diviſion) now the fourth of 24 is 6, and the third is 8, and the ſixth is 4, all which Parts, (*viz.* 6, 8, and 4) being added together, make but 18, but it ſhould be 45, wherefore I ſay by the Rule of Three.

As 18 the Sum of the Parts is to the Poſition 24, ſo is 45 the given Number to 60, the true Number ſought.

For the 4th of 60 is 15, and the third of 60 is 20, and the ſixth of 60 is 10, which added together make 45.

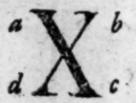
Queſt. 2 Three Perſons, *viz.* A, B, C, thus diſcourſe together concerning their Age, quoth B to A, I am as old, and half as old again as you, then quoth C to B, I am twice as old as you, then quoth A to them, and I am ſure the Sum of all onr Ages is 165, now I demand each Man's Age? *Anſwer*, A 30, B 45, C 90 Years of Age, which added together, make 165.

CHAP. XXXII.

Double Poſition.

1. THE Rule of Double Poſition, is, when 2 falſe Poſitions are aſſum'd to give a Reſolution to the Queſtion propounded.

2. When any Queſtion is ſtated in double Poſition make ſuch a Croſs as followeth.



3. Then make choice of any Number you think may be convenient for your working, which call your firſt Poſition, and place it at the end of the Croſs at *a*, then work with this Poſition, (as if it were the true

Number ſought (according to the nature of your Queſtion, then having found out your Error, either too much or too little, place it on that ſide the Croſs *d*, then make choice of another Number of the ſame Denomination with the firſt Poſition (which call your ſecond Poſition) and place it on that ſide of the Croſs at *b*, then work with this Poſition as with the former, and having found out your Error, either too much or too little, place it on that ſide of the Croſs at *c*, and then the Poſitions will ſtand at the top of the Croſs, and the Errors at the bottom, each under the correſpondent Poſition, and then multiply the Errors into the Poſition croſs-wiſe, that is to ſay, multiply the firſt Poſition by the ſecond Error, and the ſecond Poſition by the firſt Error, and put each Product over its *Poſition*.

4. Having proceeded ſo far, then conſider whether the Errors were both alike; that is, whether they were both too much, or both too little, and if they are alike; then ſubtract the leſſer product from the greater, and ſet the Remainder for a Dividend, then ſubtract the leſſer Error from the greater, and let the Remainder be a Diviſor, then the Quotient ariſing by this Diviſion, is the Anſwer to the Queſtion.

5. But if the Errors are unlike, that is, one to much, and the other too little, then add the *Products* of the *Poſitions* and *Errors* together, and their Sum ſhall be a Dividend, then add the Errors together, and their Sum ſhall be a Diviſor, and the Quotient ariſing hence is the Anſwer; which two laſt Rules may be kept in Memory by this Verſe following, *viz.*

When Errors are of unlike Kinds
Addition *doth enſue,*
But if alike Subtraction *finds*
Dividing Work for you

Qu. 1. A, B and C built a Houſe which coſt 76 *l.* of which, A paid a certain Sum unknown, B paid as much as A, and 10 *l.* over, and C paid as much as A and B; now I deſire to know each Man's Share in that Charge?

Having made a Croſs according to the ſecond Rule, I come according to the third Rule to make choice of my firſt Poſition and here I ſuppoſe A paid 6 *l.* which I put upon the Croſs as you ſee, then B paid 16 *l.* (for its ſaid he had paid 10 *l.* more than A) and C paid 22 *l.* for its ſaid he paid as much as A and B, then I add their Parts.

l.					*l.*
9				A	6
19				B	16
28	120	168	288	C	22
—	6	X	9		—
56	2)		(14	*Sum*	44
	32		20		
76		12			76
56					44
—					—
20				*Error*	32

And the amount to 44, but it is ſaid they paid 76 *l.* wherefore there is 32 too little, which I note down at the Bottom of the Croſs under its *Poſition* for the firſt Error

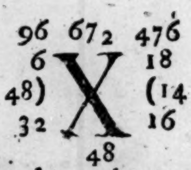
Secondly, I ſuppoſe A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together makes 56, but they ſhould make 6, wherefore the Error of this *Poſition* is 20, which I put at the bottom of the Croſs under its *Poſition* for the ſecond Error, then I multiply the Errors and the *Poſitions* croſs-wiſe, *viz.* 32 (the Error of the firſt *Poſition*) by 9 (the ſecond *Poſition*) and the *Product* is 120.

Then (according to the 4th Rule) I ſubtract the leſſer *Product* from the greater, *viz.* 120 from 288, becauſe the Errors are both alike, (*viz.* too little) and there remaineth 168 for a Dividend, then I ſubtract 29, (the leſſer Error) from 32, the greater Error, and the Remainder is 12, for a Diviſor, then I divide 168 by 12, and the Quotient is 14 for the Anſwer, which is the Share of A in the Payment.

6 Again Secondly, if the Errors hath been both too big, it had had the ſame Effect, as appeareth by the following Work; for firſt, I ſuppoſe A paid 20 *l.* then B paid 30 *l.* and C 50 *l.* which in all is 100 *l.* but it ſhould have been no more than 76, wherefore the firſt Error is 24 too much. Again, I ſuppoſe A paid 18 *l.* then B muſt pay 28 *l.* and C muſt pay 46 *l.* which in all is 92 *l.* but it ſhould have been but 76 *l.* wherefore the ſecond Error is 16 too much, then I multiply 20 (the firſt *Poſition*) by 16 (the ſecond Error) and the Product is 320; again, I multiply 18 (the ſecond *Poſition*) by 24 (the firſt Error) and the Product is 432 Then becauſe the Errors are both too much, I ſubtract 320 (the leſſer Product) from 432 (the greater *Product*) and there remaineth 112 for a Dividend; likewiſe I Subtract 16 (the leſſer Error) from 33 (the greater Error) and the Difference is 8 for a Diviſor, then perform Diviſion, and the Quotient is 14 (as before) for the Anſwer.

20 A				A 18
30 B				B 28
50 C	320	112	432	C 46
	20		18	
100 *Sum*	8)	X	(14	*Sum* 92
76 *Subtr.*	24		16	*Subtr.* 76
		8		
24 *Error*				*Error* 16

Again, Thirdly, if the Errors had been the one too big, and the other too little, reſpect being had to the fifth Rule foregoing, the Anſwer would have been the ſame; as thus, I take for my firſt *Poſition 6*, and then the Error is 32 too little, then I take for my ſecond Poſition 18; and then the Error is 16 too much, then I multiply the Poſitions and Errors croſs-wiſe, and the Products are 96 and 576, and becauſe the Errors are unlike,



(*viz.*) one too big, and another too little, I add the Products 96 and 576 together, and their Sum is 672 for a Dividend; I likewiſe add the Errors 32 and 16 together, and their Sum is 48 for a Diviſor, then having finiſh'd Diviſion, I find the Quotient to be 14, which is the Anſwer as was found out at the 2 ſeveral Trials before.

For Proof of the Work, I ſay,	*l.*
If A *paid* ————————————	14
Then B *paid* 14 *and* 10 (*that is*) ———	24
Then C *paid* 14 *and* 24 (*that is*) ———	38
The Sum of all is	76

which is a Total Value of the Building, and equal to the given Number.

Thoſe who deſire to ſee the Demonſtration of this Rule, let them read the *7th* Chapter of Mr. *Kerſey*'s Appendix to Mr. *Wingate*'s Arithmetick, *Petiſcus* in the *5th* Book of his *Trigonometria*, or Mr. *Oughtred* in his *Clavis Mathematica*.

Queſt. 2. Three Perſons, A, B and C, thus diſcourſed together concerning their Age; quoth A, I am 18 Years of Age; quoth B, I am as old as A and ½ C; and quoth C, I am as old as you both, if your Years were added together. Now I deſire to know the Age of each Perſon? *Anſwer*, A is 18, B is 55, and C is 72 Years of Age.

Queſt. 3. A Father lying at the point of Death, left to his 3 Sons, *viz.* A, B, C, all his Eſtate in Money, and divideth it as followeth, *viz.* to A he gave $\frac{1}{2}$ wanting 44 *l.* to B he gave $\frac{1}{3}$ and 14 *l.* over, and to C he gave the Remainder, which was 82 *l.* leſs than the Share of B, now I demand what was the Sum left, and each Man's Part? *Anſwer,* The Sum bequeathed was 588 *l.* whereof A had 250 *l.* B had 210 *l.* and C had 128 *l.*

Queſt. 4. Two Perſons, *viz.* A and B had each in their Hands a certain number of Crowns, and A ſaid to B, If you give me one of your Crowns, I ſhall have 5 times as many as you; and ſaid B to him again, if you give me one of yours, then we ſhall each of us have an equal Number: now I demand how many Crowns had each Perſon? *Anſwer,* A had 4, and B had two Crowns.

Queſt 5. What Number is that to which if I add $\frac{1}{4}$ of itſelf, and from the Sum ſubtract $\frac{1}{8}$ of itſelf, the Remainder will be 210? *Anſwer,* 192.

Many more Queſtions may be added, but theſe well underſtood, will be ſufficient, (even for the meaneſt Capacity) for the Reſolution of any other Queſtion pertinent to this Rule.

There may be an Objection made becauſe we have not treated particularly upon Intereſt and Rebate, but the Operation of ſuch Queſtions being more applicable to Decimals, are omitted, till we come to acquaint the Learner therewith.

Laus Deo Soli.

FINIS.

Advertiſement.

THere is lately brought from *Chili*, a Province in *America* a moſt Excellent Natural Balſam, far exceeding that of *Peru* and *Tolu*, in curing moſt Diſeaſes in human Bodies; as it hath given Demonſtration: 'Tis a Remedy no Man under the Sun can compoſe, as being a moſt Odoriferous and Natural Balſam. It cures all Pains proceeding from Cold, corroborates the Stomach, creates an Appetite, and ſtrengthens the whole Body: It is a wonderful Remedy for all internal Sores, Bruiſes, Ulcers, *&c.* and mightily helps all Aſthmatical Diſtempers: 'Tis alſo a great Cephalick, helping moſt Diſeaſes of the Head, and ſtrengthning the Brain and Nerves: It kills the Worms, provokes Urine, and is good againſt the Stone; helps all Fluxes of the Belly, is excellent in all Diſeaſes of the Ears, eſpecially Deafneſs: It alſo cures all manner of green Wounds.

Note, *It is only to be had of* Eben. Tracy, *at the Three Bibles on* London-bridge *at* 1 s. 6 d. *the Ounce; the Bottles are Seal'd with the Balſam-tree.*

this may be Read whe
I am dead and all m
Boness are Rotten whe
ths yu see Remember
mee yt i be not for
gotten